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INVESTIGATION OF PROPOSED REDUCED PRESERVATION-PACKAGING METHOD--ETC(U)
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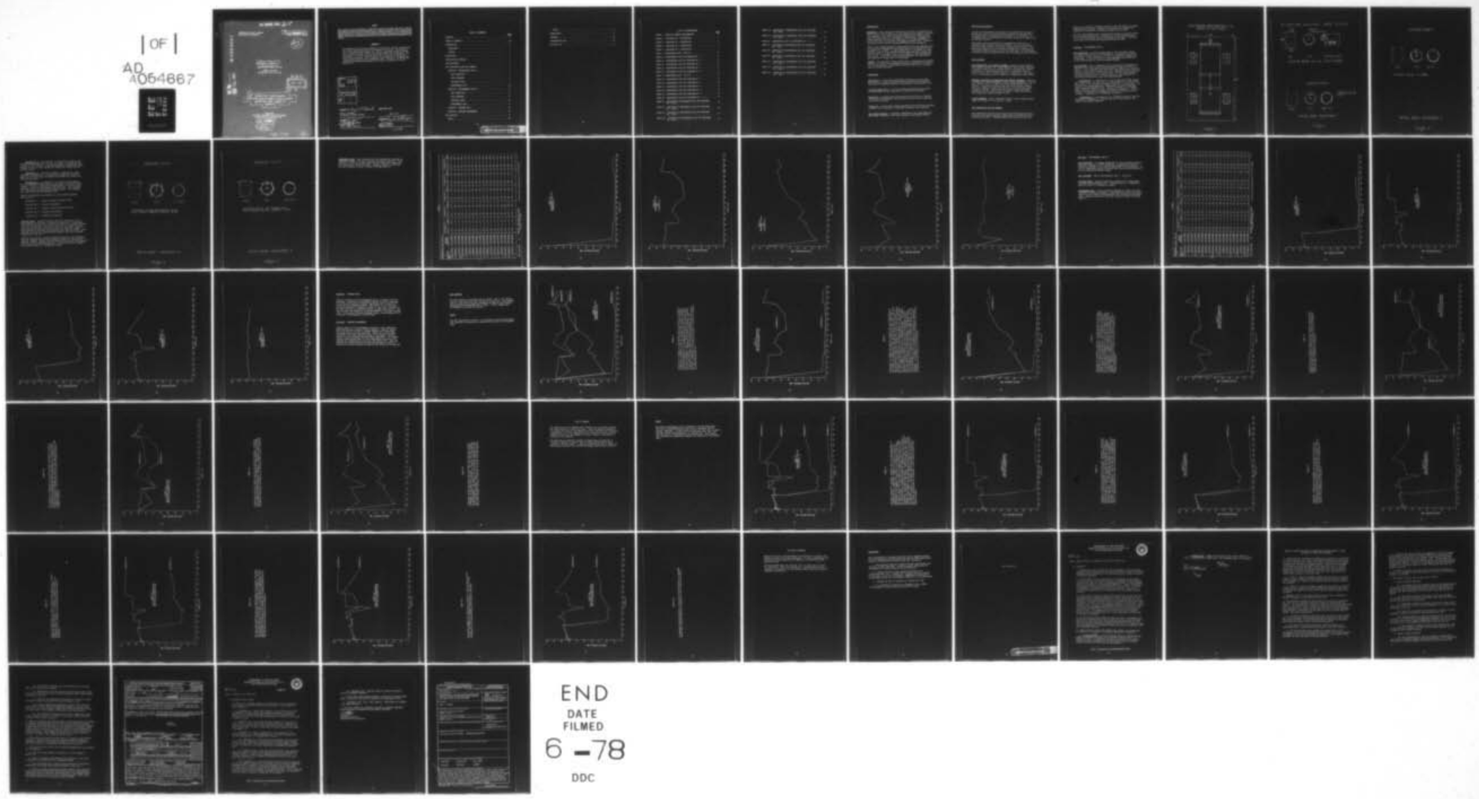

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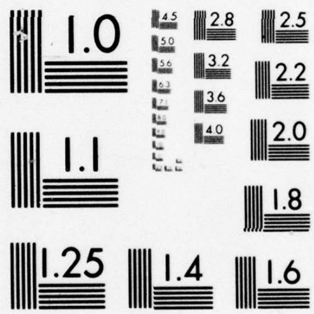

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AFPEA PROJECT 77-P7-33

10 DARYL A. EDWARDS
Engineering Student Trainee

AUTOVON 787-3120
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6 INVESTIGATION OF PROPOSED REDUCED PRESERVATION-PACKAGING METHODS FOR NESTED EXTERNAL AIRCRAFT FUEL TANKS IN MIL-C-9361 CONTAINERS,

AFALD/PTP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

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NOTICE

ABSTRACT

Two experimental tests were conducted to evaluate the relative effectiveness of military specification MIL-P-116 Methods IA-5 and IId. The objective was to determine whether Method IA-5 could be specified instead of Method IId for nested external aircraft fuel tanks in MIL-C-9361 containers. The conclusions of the test show that Method IId is superior to Method IA-5 when properly prepared. Also, shown was the possibility of the Method IA-5 causing more harm than good if improperly used. Therefore, the Method IId preservation-packaging requirement for storage is necessary in lieu of Method IA-5.

PREPARED BY: Daryl A. Edwards

DARYL A. EDWARDS
ENGINEERING STUDENT TRAINEE

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REVIEWED BY: Ralph Zynda

RALPH ZYNDA
CHIEF, DESIGN DIVISION

APPROVED BY: Jack E. Thompson

JACK E. THOMPSON
DIRECTOR, AFPEA

30 MAR 1978

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INTRODUCTION

BACKGROUND: This project was initiated as a result of an AFTO Form 22 dated 11 April 1977 followed by a more detailed letter dated 1 June 1977 (see Appendix). The intent of these documents was to modify the Air Force Technical Order T.O. 00-85A-03-1, "Preservation, Packaging and Packing External Aircraft Fuel Tanks/Cells," to allow packaging of nested fuel tanks in accordance with MIL-P-116 Method IA-5. Presently, only Method IId is used as the method of preservation-packaging.

Based on the evidence gathered during previous tests and submitted with the documents in Appendix-A, the effectiveness of the Method IId pack appeared to be in doubt. It was assumed that if the Method IA-5 pack could be shown to be as effective or more effective than a Method IId pack and the T.O. changed, then a cost savings in labor and materials would result. With this as background information, the AFTO Form 22 was submitted to change the T.O. accordingly.

PURPOSE: The objective of this project was to investigate the proposed reduction in preservation-packaging methods by comparing the effectiveness of both methods. Disposition of the AFTO Form 22 will be based upon the results obtained.

DEFINITIONS

AFTO Form 22 - A form which establishes procedures for correcting deficiencies in existing Technical Orders and preliminary Technical Orders and is intended primarily for operational and maintenance use.

Technical Order (T.O.) - A formal statement establishing procedures for operational use and maintenance of equipment and systems.

Method IA-5 - A preservation method described in MIL-P-116, "Methods of Preservation-Packaging," and utilizing a sealed, water vaporproof, rigid metal container.

Method IId - A preservation method described in MIL-P-116 and utilizing a sealed, water vaporproof, rigid metal container, with desiccant.

MIL-C-9361 Container - A container conforming to the requirements of MIL-C-9361, "Container, Fuel Tank, External, Disassembled, Nested."

INVESTIGATION APPROACH

In order to substantiate the proposal to use Method IA-5 in lieu of Method IId, it must be shown that the inclusion of desiccant does not significantly increase the effectiveness of the container. To accomplish this, two experimental tests were conducted to compare the two methods involved.

Experimental data was generated by instrumented containers in a temperature and humidity controlled chamber. The test containers used were drums of equal size, shape, and physical condition. Four drums were prepared so as to have one variable such as desiccant or no desiccant differing from at least one other drum. In this manner, an analysis based on comparisons was used for developing the conclusions.

TEST EQUIPMENT

HIGH TEMPERATURE, HIGH HUMIDITY CHAMBER - Manufactured by Standard Environmental Systems, Inc., Model SMTH/960, serial number 2815 with a Honeywell Servoline 45 Recorder/Controller utilizing wet bulb/dry bulb sensors. The chamber operates with a temperature range of $+35^{\circ}F$ to $+200^{\circ}F$ $\pm 3^{\circ}F$. Chamber humidity is controlled in the range of 20 to 95% RH $\pm$5% RH but is limited by a minimum dew point of $45^{\circ}F$.

HONEYWELL ELECTRONIC 15 TEMPERATURE AND HUMIDITY RECORDER - Model No. Y15303816-(24)-(48)-0-000-006-10, serial number R5838800002. The unit has a range of $-30^{\circ}F$ to $+150^{\circ}F$ and 0% RH to 100% RH with up to 24 channels. Testing was conducted with the Q457A humidity sensors. They have a range of 5% RH to 95% RH with a total humidity system accuracy of $\pm$4% RH. Temperature sensors were nickel resistance thermometer "A" bulb with a range of $+40^{\circ}F$ to $+120^{\circ}F$ and allows a total temperature system accuracy of $\pm 1^{\circ}F$.

U-TUBE MANOMETER - Meriam Instrument Company, serial number RC-4615, range -37 in H_2O to +37 in H_2O $\pm$0.1 in H_2O.

TEST PREPARATION AND DATA SUMMARY

The experimental portion of the project was divided into two tests. These two tests should provide a sound basis for comparison of the preservation methods. Distinguishing characteristics of the two

tests are the initial conditions, varied so that the effects of initial conditions may be shown. Primarily the container with Method IA-5 preservation should show a difference between the two tests.

The first environmental test is discussed in Section-A with the second test discussed in Section-B. Pressure test results performed prior to the two environmental tests are discussed in Section-C. Section-D covers some of the problems encountered during the tests.

SECTION-A. ENVIRONMENTAL TEST I

TEST OBJECTIVES: To develop comparisons of test containers sealed or closed at conditions of 65°F and 80% RH. To monitor the internal environment of each container as a series of temperature changes are encountered. To use the results of the comparisons to provide data on the effectiveness of various packaging methods.

TEST SPECIMENS: Test I consisted of five containers instrumented and installed in the High Temperature/High Humidity Chamber as shown in Figure 1. Four containers were MIL-D-6054 steel drums with a 16-gallon capacity and the fifth container was a F-4, 600-gallon nested fuel tank canister loaded with four F-4 nested tanks. The fuel tank container was carried along just as a matter of interest. The specimens are identified and described in the following paragraphs.

CONTAINER NO. 1 - Container No. 1 was an empty MIL-D-6054 sixteen gallon steel drum. The drum has an inside diameter of 15-5/16 inches and a depth of 19-7/8 inches yielding a volume of 2.12 cubic feet. The container was instrumented with a temperature and relative humidity sensor connected through the lid. The lid is sealed by a "D" shape gasket and drawn tight by a ring, nut and bolt arrangement. Prior to sealing, the container was examined and found to be dry and free of corrosion. Container No. 1 is detailed in Figure 2.

CONTAINER NO. 2 - Container No. 2 is detailed in Figure 3 and was identical to Container No. 1 except that the lid was rusty on the inside from previous exposures.

CONTAINER ARRANGEMENT IN HUMIDITY CHAMBER

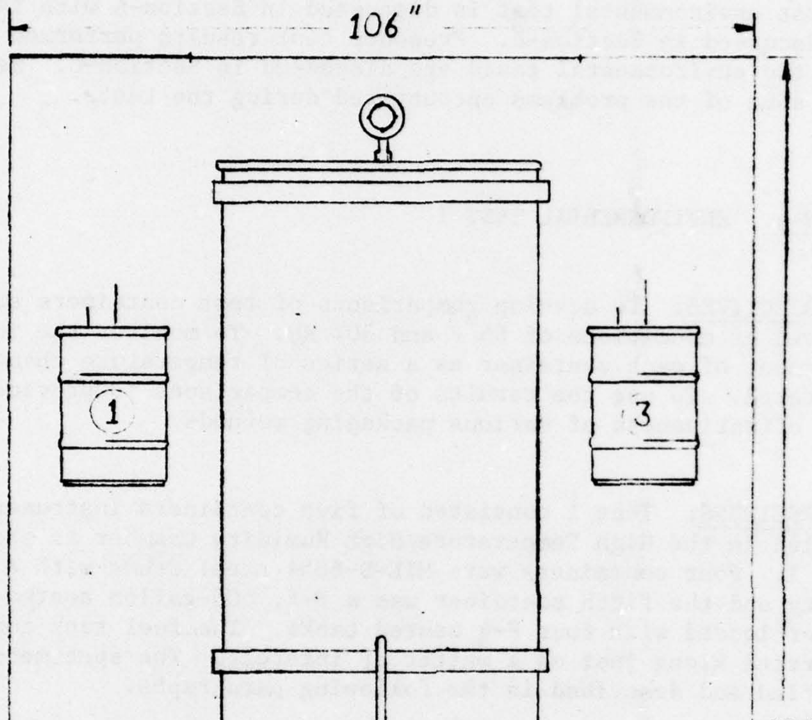
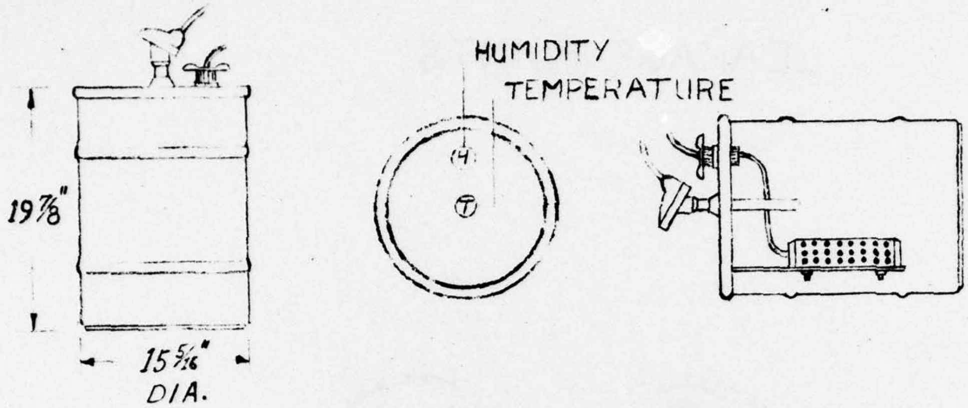


FIGURE 1

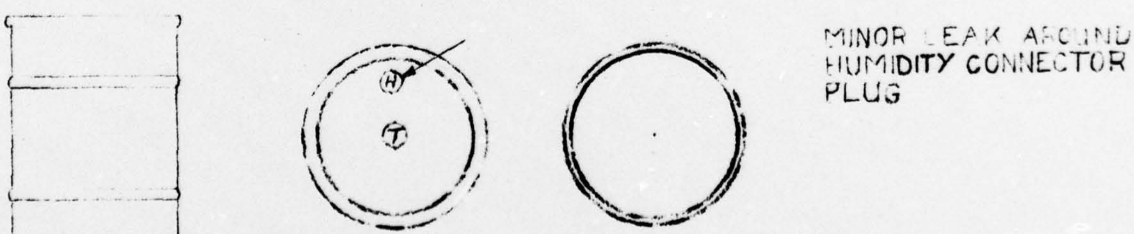
TEMPERATURE AND HUMIDITY PROBE LOCATION



SIDE TOP TRANSPARENCY

LOCATION SAME ON ALL CONTAINERS

LEAKAGE POINTS

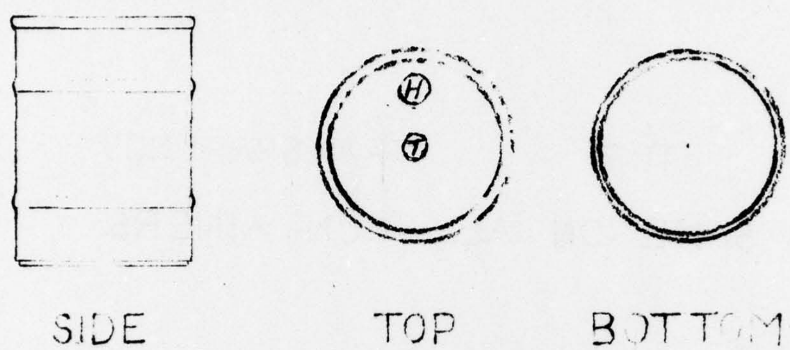


SIDE TOP BOTTOM

METAL DRUM - CONTAINER 1

FIGURE 2

LEAKAGE POINTS



CONTAINER SEALED - NO LEAKS

METAL DRUM - CONTAINER 2

FIGURE 3

CONTAINER NO. 3 - Container No. 3 is detailed in Figure 4 and differs from Container No. 1 in that the gasket is missing and the interior of the container is partially corroded. Deleting the gasket allowed the lid to easily rotate even though the closing ring was securely bolted.

CONTAINER NO. 4 - Detailed in Figure 5, Container No. 4 was identical to Container No. 1 except that no gasket was provided. Again the lid could easily be rotated even though the closing ring was securely bolted.

CONTAINER NO. 5 - Container No. 5 was a MIL-C-9361 canister for F-4, 600-gallon nested external fuel tanks. The canister had a length of 13 feet 5 inches and an inside diameter of 40-1/2 inches creating a volume of approximately 120 cubic feet. This container had a few known leaks but was not pressure tested. The container was loaded during the environmental test.

Each of the containers was prepared to the following container function list:

Container No. 1 - Sealed, Desiccant (IAW MIL-P-116)

Container No. 2 - Sealed, No Desiccant

Container No. 3 - Unsealed, Desiccant (IAW MIL-P-116)

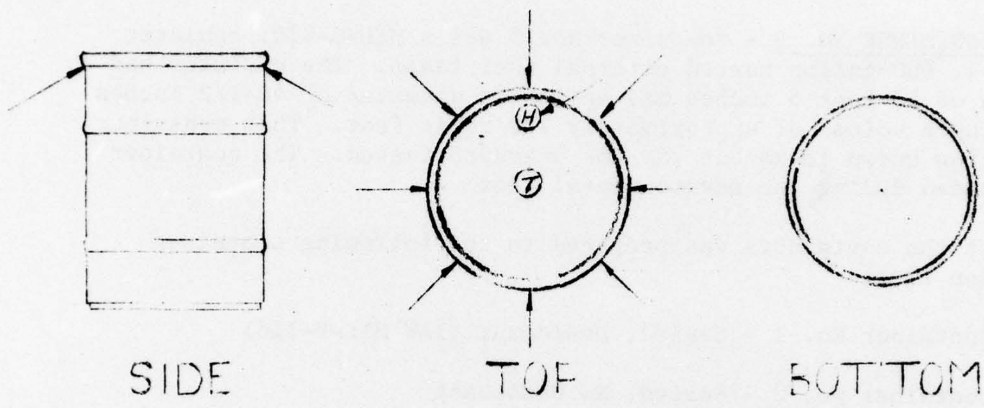
Container No. 4 - Unsealed, No Desiccant

Container No. 5 - Unsealed, No Desiccant

DESICCANT PACKS: Required desiccant packs for containers 1 and 3 were prepared in quantities as specified in MIL-P-116. The formula $U=KV + XD$ was used with $K=1.2$, $V=2.12$, and $XD=0$ for no dunnage yielding 2.54 units of desiccant. To obtain these 2.54 unit packs, a 16 unit bag of desiccant was opened and 2.54 units were removed by weight. The desiccant was then put into emptied 16 unit bags and closed. After labeling the packs for identification purposes, they were thoroughly dried prior to the test.

When the time came for installing desiccant packs into the containers, they were removed from the oven, wrapped in MIL-B-131 vapor barrier material, weighed, removed from the barrier material, and then installed. Prior to the test, desiccant pack no. 1, less the MIL-B-131, weighed 84.3 grams and pack no. 2 weighed 82.4 grams.

LEAKAGE POINTS

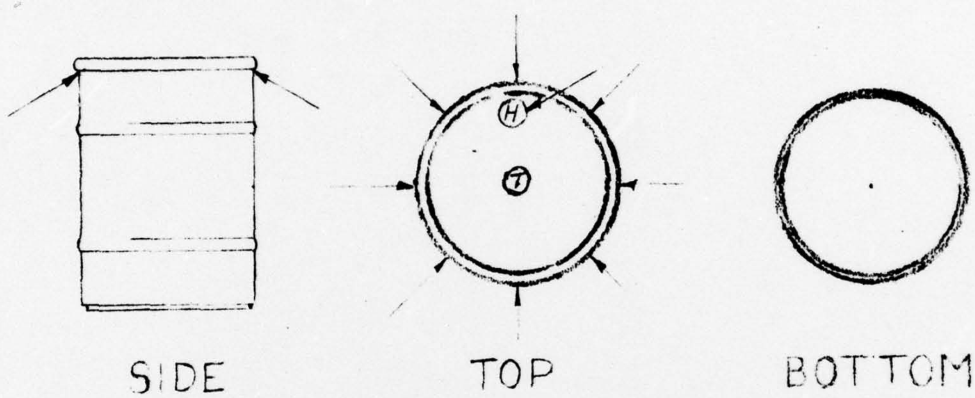


CONTAINER LEAKED 360° AROUND SEAL;
ALSO LEAKED AROUND HUMIDITY PLUG.

METAL DRUM - CONTAINER 3

FIGURE 4

LEAKAGE POINTS



CONTAINER LEAKED 360° AROUND SEAL;
ALSO LEAKED AROUND HUMIDITY PLUG.

METAL DRUM - CONTAINER 4

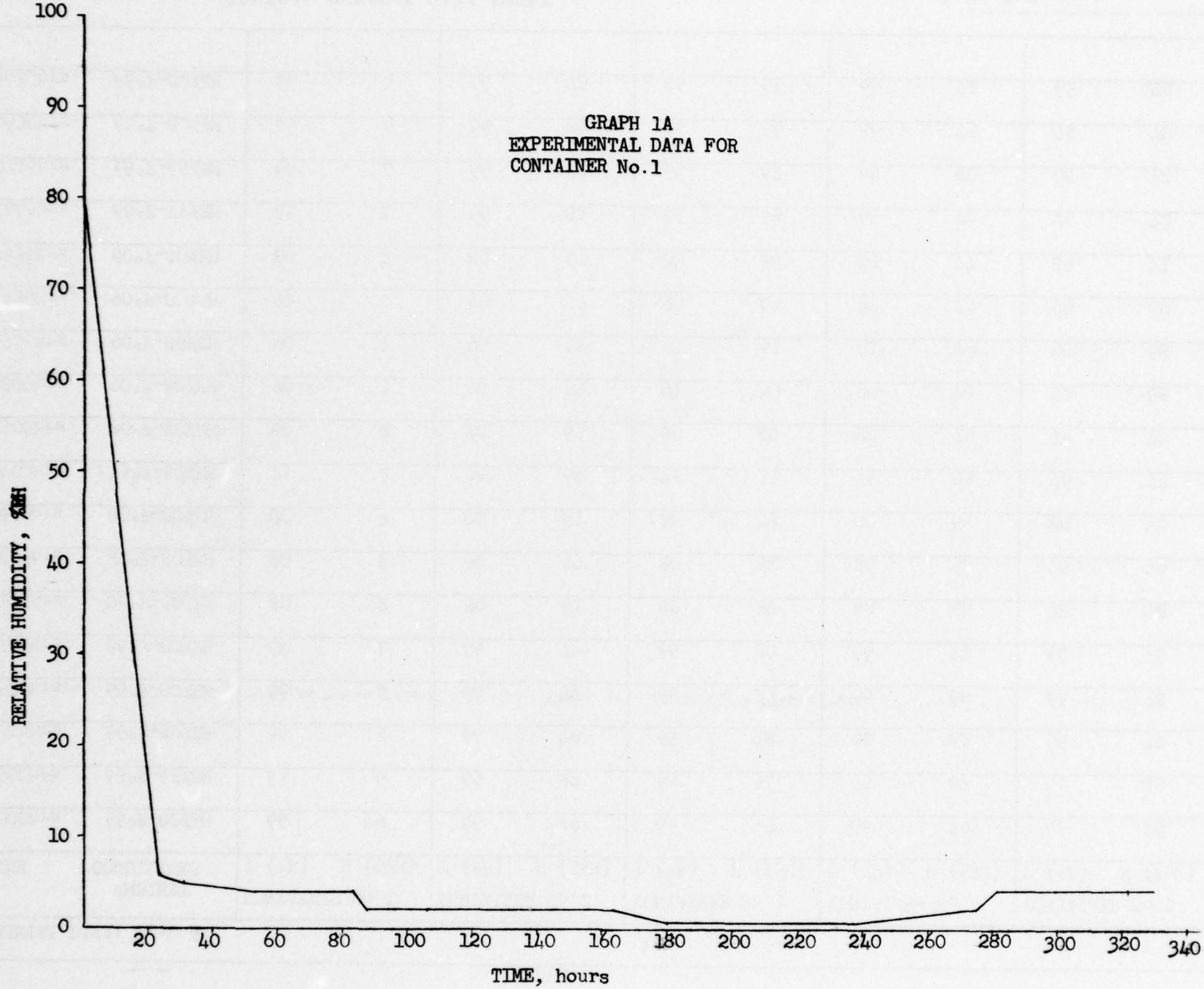
FIGURE 5

<u>EXPERIMENTAL DATA</u>: Data collected from the instrumented container is tabulated in Table 1 for each container and ambient condition. Times chosen for collection of data points were not previously planned and only collected at convenient times. Graphical display of this data for each container is given in Graph 1A through Graph 5A.

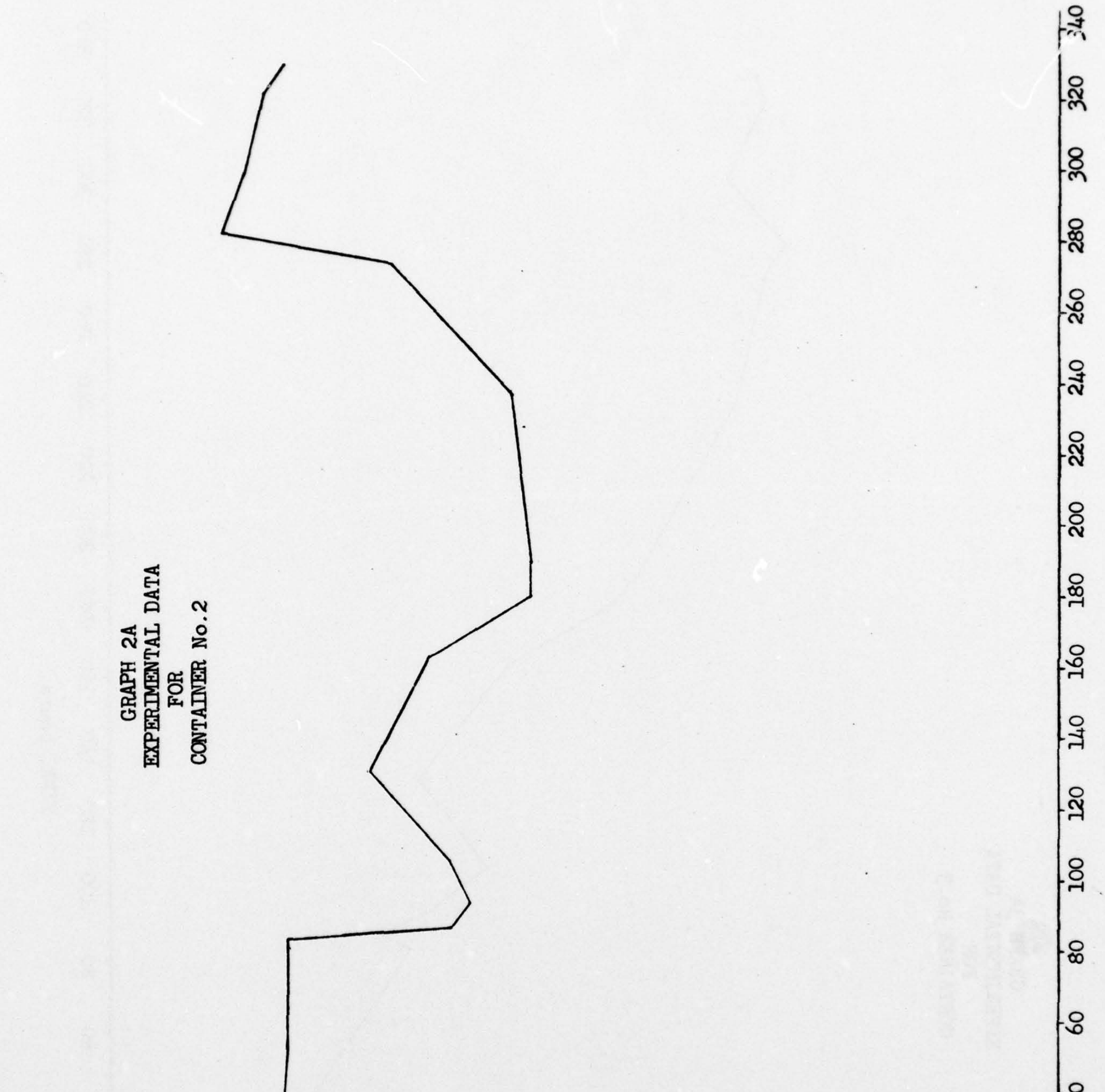
TABLE-1

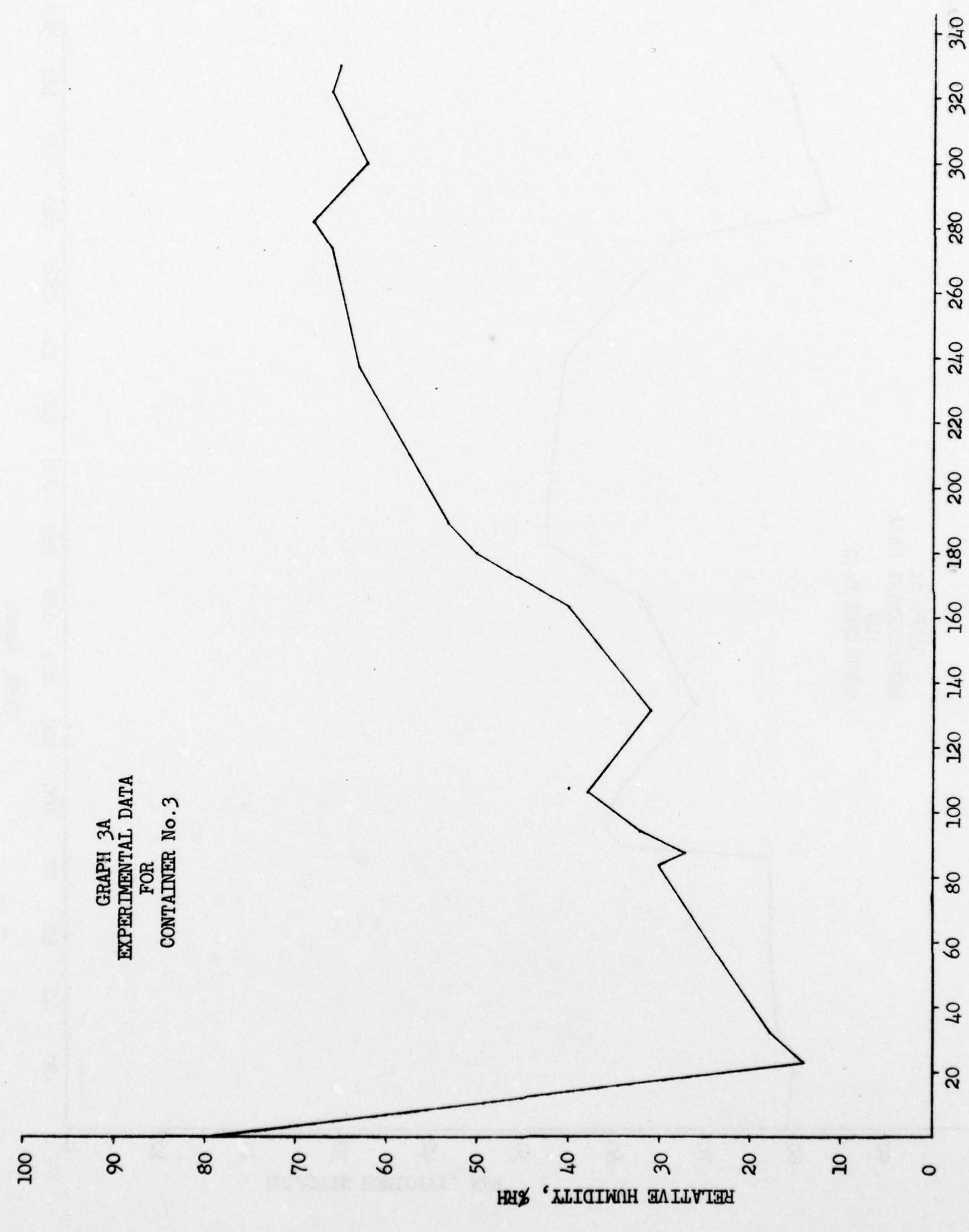
EXPERIMENTAL DATA: Test #1

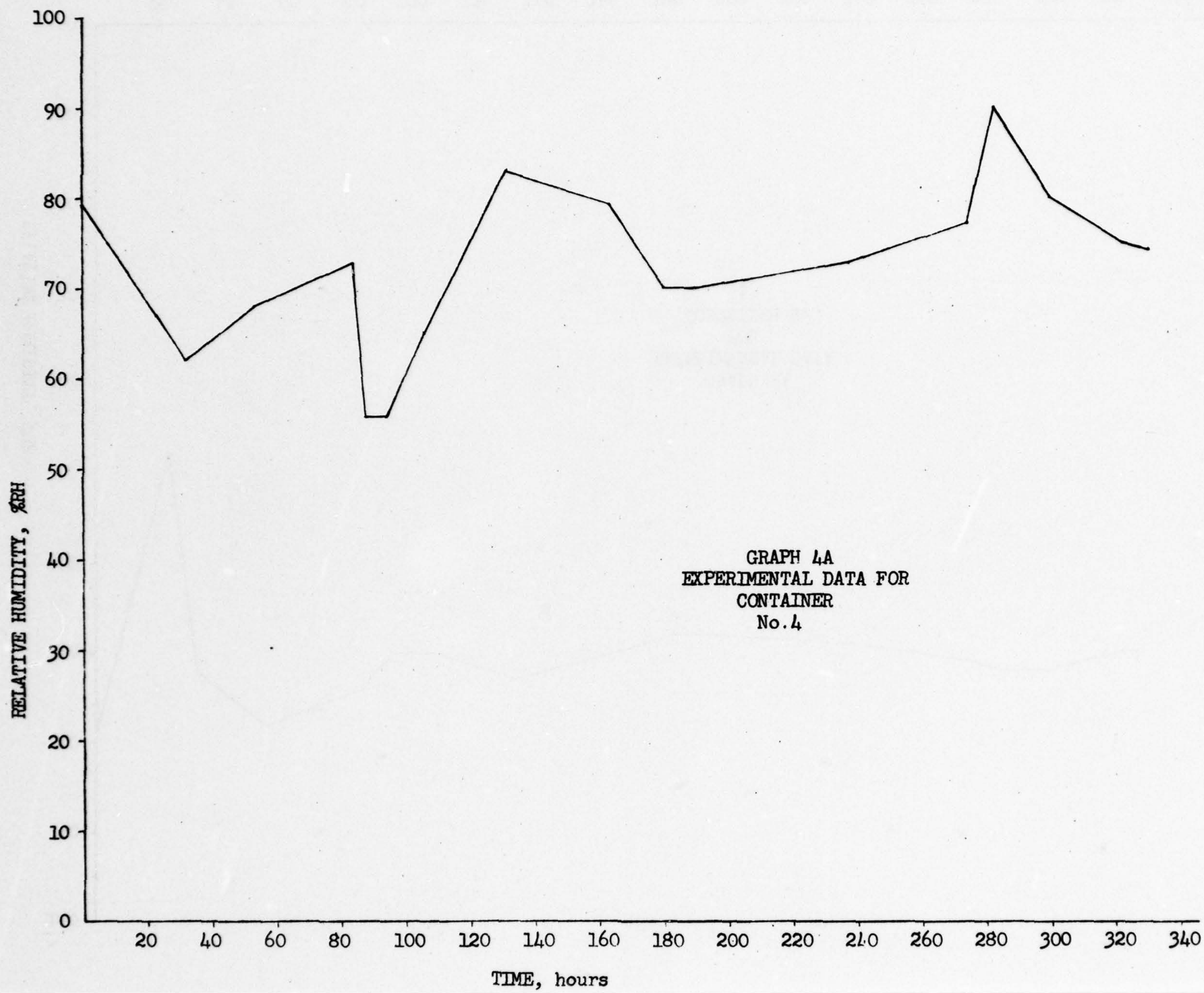
DATE	TIME	AMBIENT CONDITIONS	CONTAINER No.1 T (°F)	CONTAINER No.1 H (%RH)	CONTAINER No.2 T (°F)	CONTAINER No.2 H (%RH)	CONTAINER No.3 T (°F)	CONTAINER No.3 H (%RH)	CONTAINER No.4 T (°F)	CONTAINER No.4 H (%RH)	CONTAINER No.5 T (°F)	CONTAINER No.5 H (%RH)
SEP. 29	1000hrs.	66°F-80%RH	66	79	66	79	66	79	66	79	66	79
30	0900hrs.	65°F-65%RH	65	6	65	80	65	14	65	67	65	48
	1745hrs.	66°F-80%RH	66	5	66	78	66	18	66	62	66	72
OCT. 1	1525hrs.	66°F-80%RH	66	4	66	77	66	23	66	68	66	78
3	0745hrs.	66°F-80%RH	66	4	66	77	66	30	66	73	66	74
	1125hrs.	80°F-80%RH	80	2	80	61	80	27	80	56	72	72
	1800hrs.	80°F-80%RH	80	2	80	59	80	32	80	56	78	70
4	0630hrs.	80°F-80%RH	80	2	80	61	80	38	80	65	80	70
5	0700hrs.	75°F-60%RH	75	2	75	69	75	31	75	83	76	73
6	1500hrs.	80°F-80%RH	80	2	80	63	80	40	80	79	79	70
7	0800hrs.	90°F-80%RH	90	1	90	53	91	50	90	70	90	68
	1745hrs.	90°F-80%RH	90	1	90	53	91	53	91	70	90	68
9	1730hrs.	90°F-80%RH	90	1	90	55	90	63	90	73	90	69
11	0635hrs.	80°F-80%RH	80	2	80	67	80	66	80	77	80	71
	1445hrs.	66°F-75%RH	66	4	66	84	66	68	66	90	70	72
12	0745hrs.	66°F-65%RH	66	4	66	82	66	62	66	80	66	72
13	0630hrs.	66°F-80%RH	66	4	66	80	66	66	66	75	66	70
	1415hrs.	66°F-80%RH	66	4	66	78	66	65	66	74	66	70

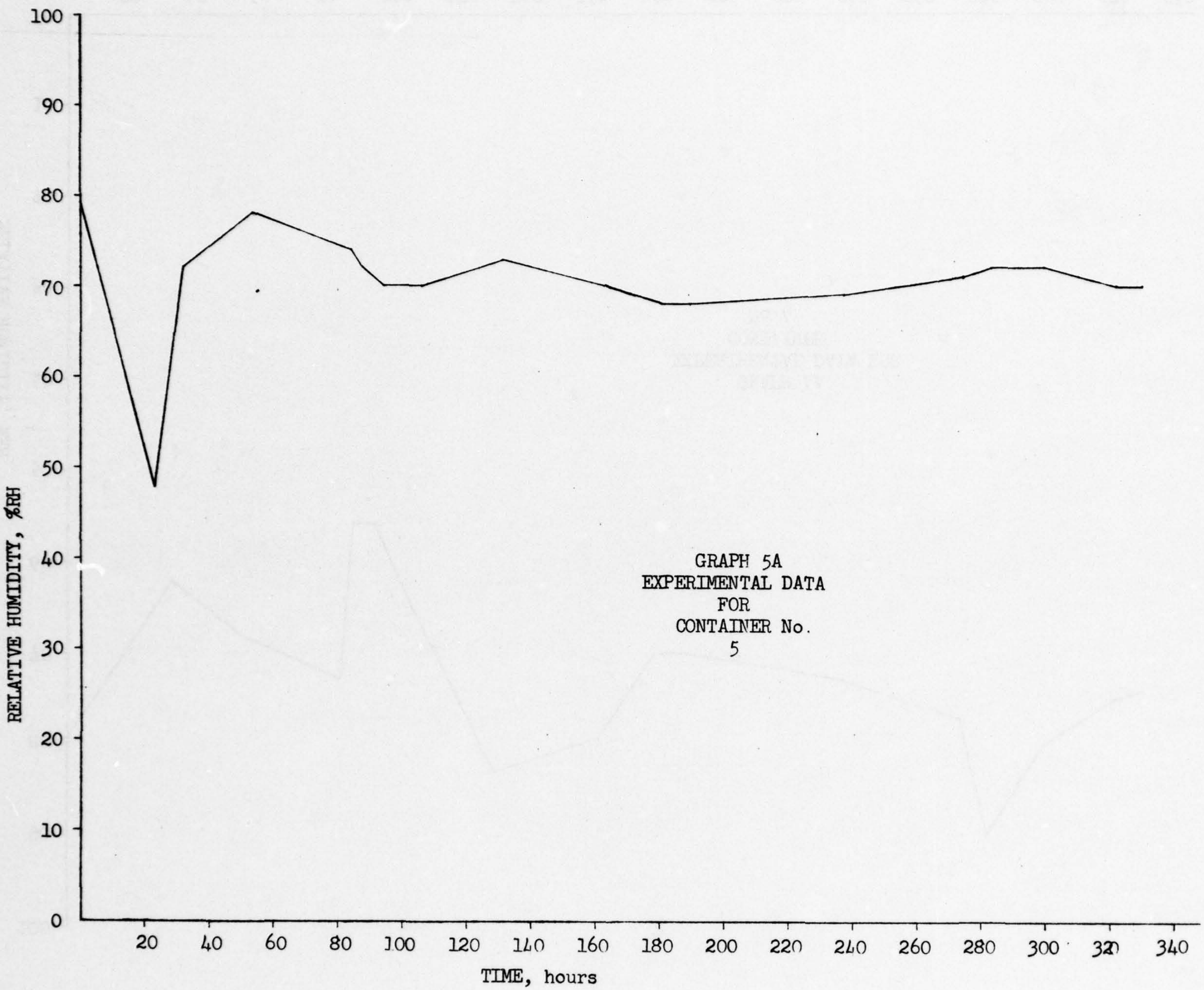


GRAPH 1A
EXPERIMENTAL DATA FOR
CONTAINER No.1


GRAPH 2A
EXPERIMENTAL DATA
FOR
CONTAINER No.2
RELATIVE HUMIDITY, %RH
0
10
20
30
40
50
60
70
80
90
100
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
TIME, hours


GRAPH 3A
EXPERIMENTAL DATA
FOR
CONTAINER No.3
RELATIVE HUMIDITY, %RH
0
10
20
30
40
50
60
70
80
90
100
TIME, hours
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340


GRAPH 4A
EXPERIMENTAL DATA FOR
CONTAINER
No.4
RELATIVE HUMIDITY, %RH
100
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
TIME, hours


GRAPH 5A
EXPERIMENTAL DATA
FOR
CONTAINER No.
5
RELATIVE HUMIDITY, %RH
TIME, hours
0
10
20
30
40
50
60
70
80
90
100
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340

SECTION-B. ENVIRONMENTAL TEST II

TEST OBJECTIVES: To develop comparisons of test containers sealed or closed at conditions of 90°F and 80% RH. To monitor the effect of temperature changes on the internal environment of each container. To use the comparative results to provide data about the effectiveness of the two preservation methods tested.

TEST SPECIMENS: Same as Environmental Test I - Section-A.

DESICCANT PACKS: Desiccant packs were prepared in the same manner as those in Environmental Test I. Desiccant pack no. 1 weighed 83.7 grams and pack no. 2 weighed 81.9 grams.

EXPERIMENTAL DATA: Data collected is tabulated in Table 2 for each container and ambient condition. Times chosen for collection of data points were not rigidly established and only collected at convenient times. Graphical display of this data is given in Graph 1B through Graph 5B.

TABLE-2

EXPERIMENTAL DATA: Test #2

DATE	TIME	AMBIENT CONDITIONS	CONTAINER No.1 T (°F)	CONTAINER No.1 H (%RH)	CONTAINER No.2 T (°F)	CONTAINER No.2 H (%RH)	CONTAINER No.3 T (°F)	CONTAINER No.3 H (%RH)	CONTAINER No.4 T (°F)	CONTAINER No.4 H (%RH)	CONTAINER No.5 T (°F)	CONTAINER No.5 H (%RH)
OCT. 14	0715hrs.	90°F-70%RH	91	70	91	70	91	69	91	67	90	77
	1120hrs.	90°F-80%RH	91	76	91	75	91	74	91	74	90	76
	1755hrs.	90°F-80%RH	91	74	91	74	91	73	91	72	91	76
16	1320hrs.	91°F-80%RH	91	79	91	79	91	78	91	78	91	78
	1400hrs.	91°F-80%RH	91	55	92	75	92	68	91	75	91	78
17	0745hrs.	90°F-80%RH	91	3	91	76	91	20	91	77	90	78
	1525hrs.	90°F-80%RH	91	2	91	75	91	20	91	76	91	78
	1730hrs.	82°F-80%RH	83	3	83	84	83	18	83	84	85	79
18	0645hrs.	85°F-60%RH	85	1	85	82	85	18	85	77	85	79
	1400hrs.	82°F-60%RH	82	2	82	85	82	20	82	79	82	79
19	0745hrs.	95°F-65%RH	95	1	95	68	95	16	95	51	93	75
	0830hrs.	84°F-65%RH	87	1	86	72	86	17	86	57	90	75
	1045hrs.	83°F-65%RH	83	1	83	84	83	19	83	69	87	78
20	0630hrs.	80°F-65%RH	80	1	80	85	80	23	81	70	81	78
	1545hrs.	80°F-80%RH	80	1	80	85	80	25	80	71	80	77
21	0855hrs.	80°F-70%RH	80	2	80	84	80	30	80	74	80	77
	1730hrs.	66°F-65%RH	67	3	67	95	67	28	67	88	72	79
23	1600hrs.	66°F-65%RH	66	4	66	95	66	30	66	74	66	76
25	0635hrs.	66°F-65%RH	66	4	66	94	66	34	66	66	66	75

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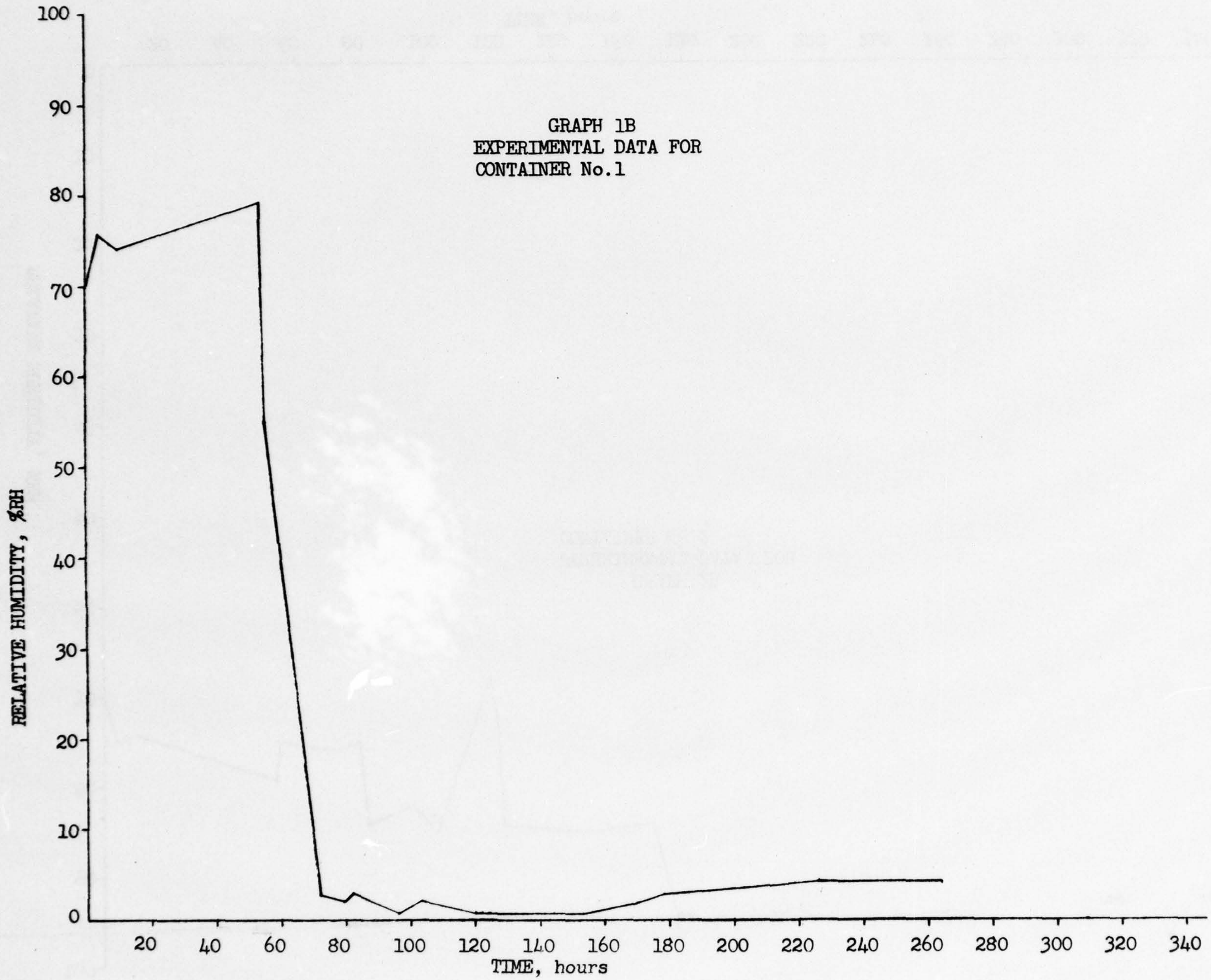
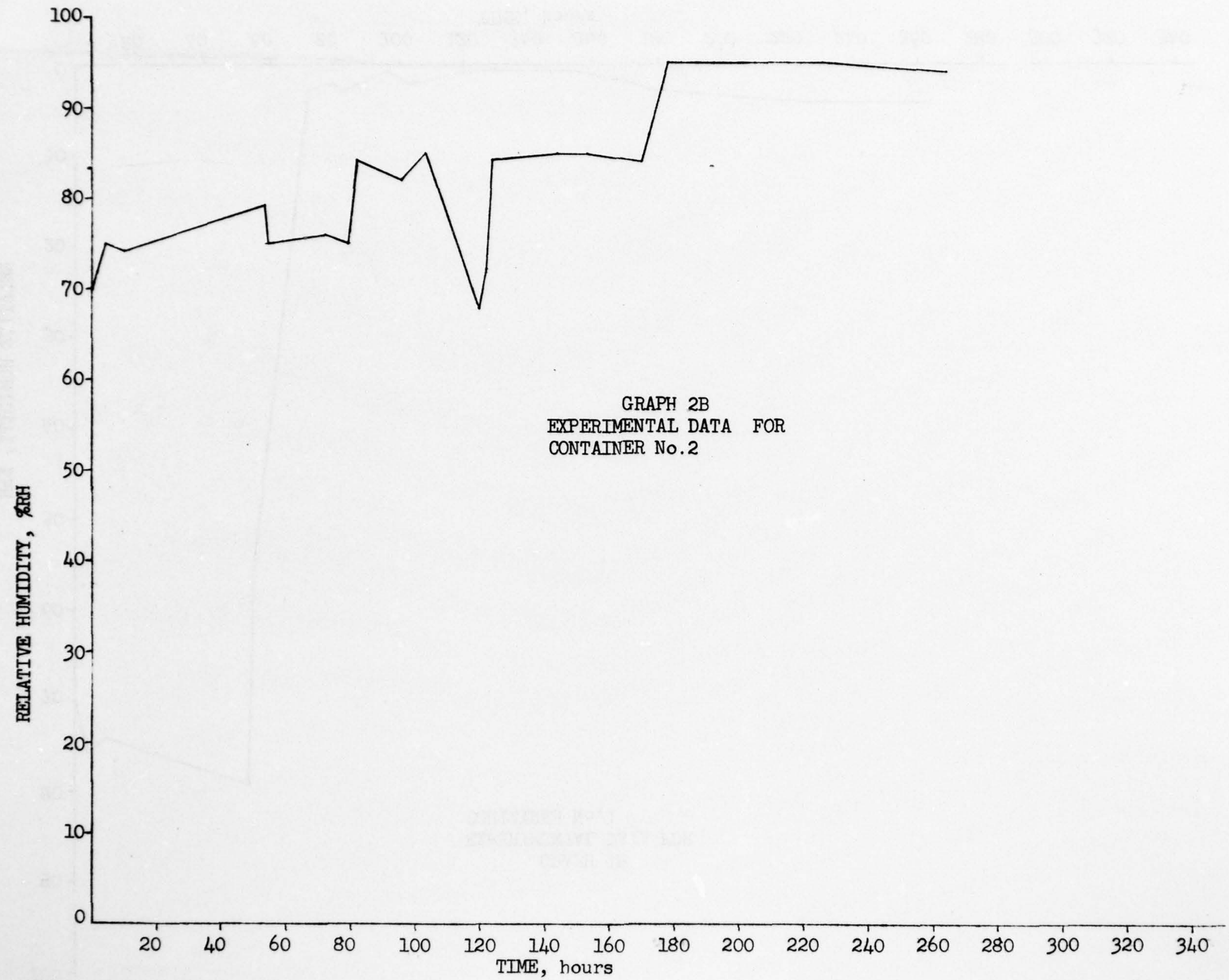

GRAPH 1B
EXPERIMENTAL DATA FOR
CONTAINER No.1
RELATIVE HUMIDITY, %RH
100
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
TIME, hours


GRAPH 2B
EXPERIMENTAL DATA FOR
CONTAINER No.2
RELATIVE HUMIDITY, %RH
0
10
20
30
40
50
60
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TIME, hours
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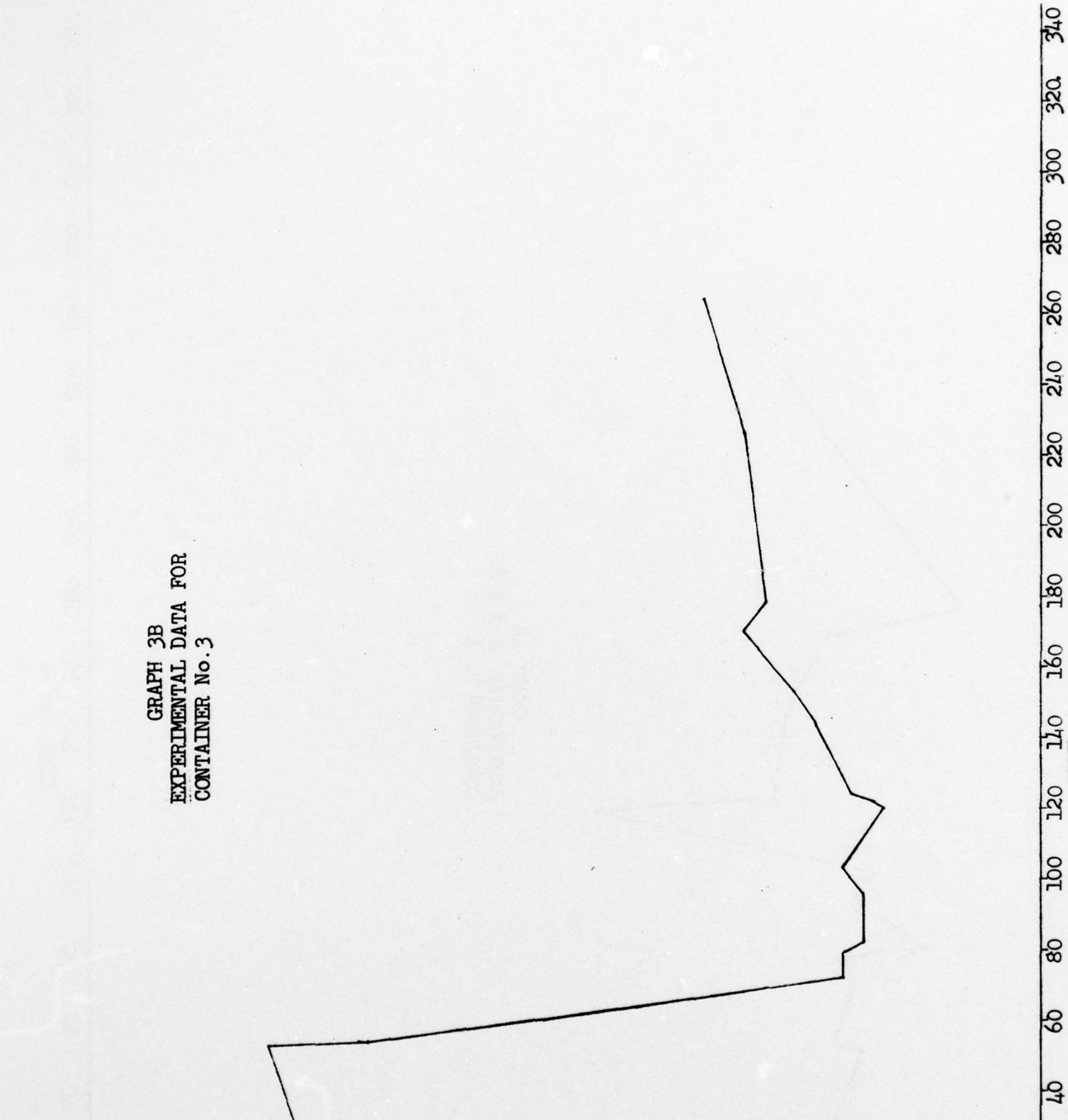
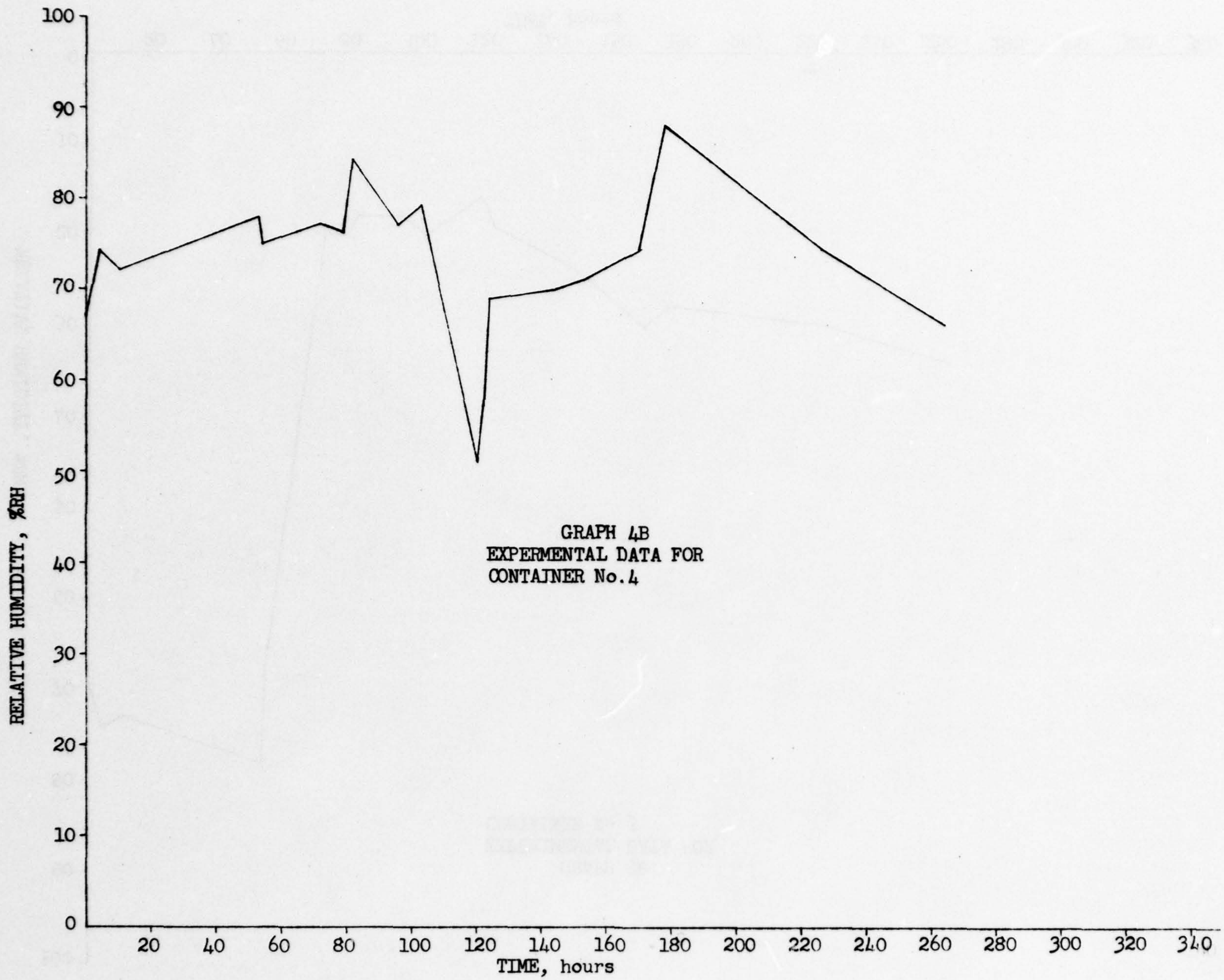


GRAPH 3B
EXPERIMENTAL DATA FOR
CONTAINER No. 3


GRAPH 4B
EXPERMENTAL DATA FOR
CONTAINER No.4
RELATIVE HUMIDITY, %RH
TIME, hours
0
10
20
30
40
50
60
70
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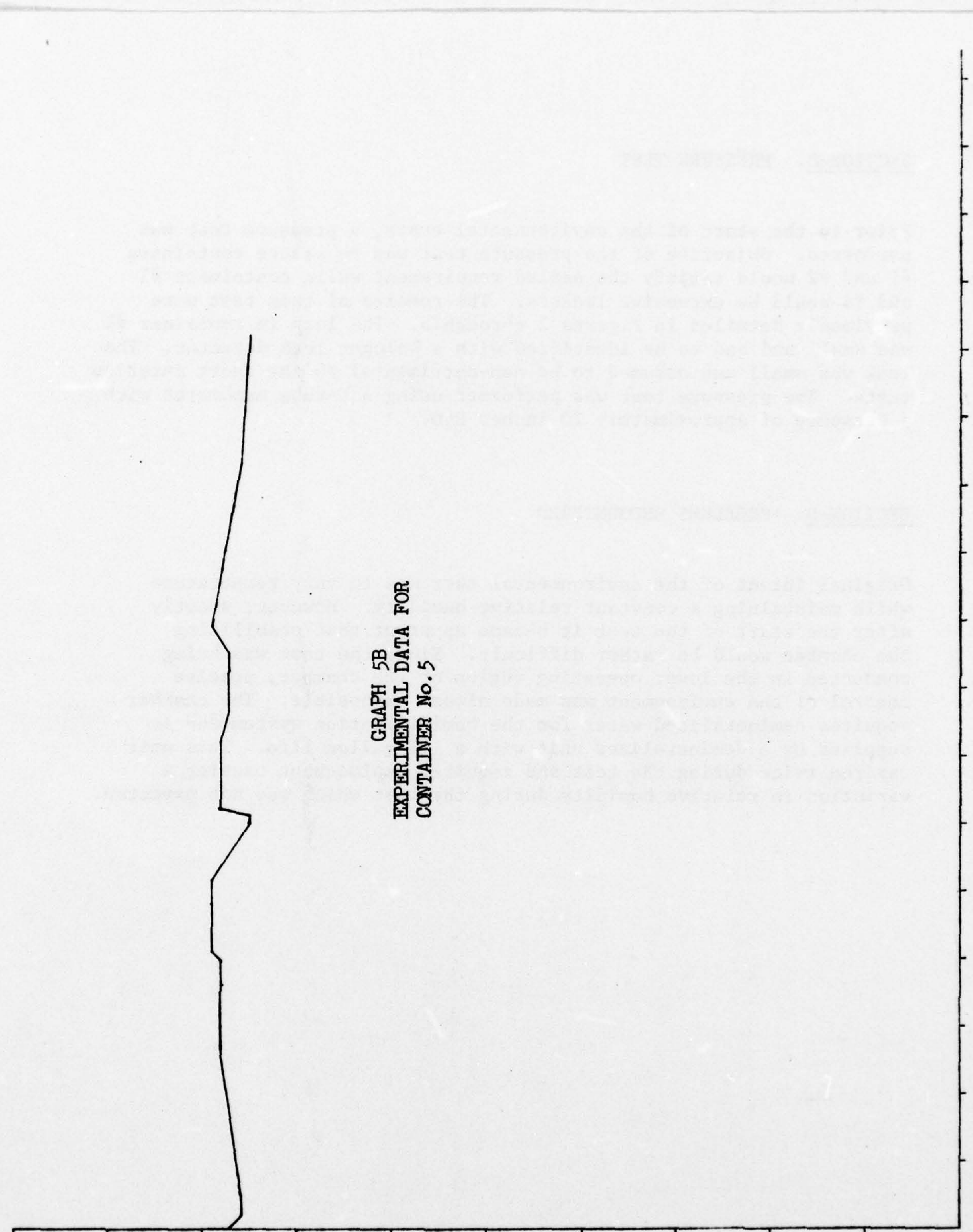


GRAPH 5B
EXPERIMENTAL DATA FOR
CONTAINER No. 5

SECTION-C. PRESSURE TEST

Prior to the start of the environmental tests, a pressure test was performed. Objective of the pressure test was to assure containers #1 and #2 would satisfy the sealed requirement while containers #3 and #4 would be extensive leakers. The results of this test were previously detailed in Figures 2 through 5. The leak in container #1 was small and had to be identified with a halogen leak detector. The leak was small and assumed to be non-detrimental to the short duration tests. The pressure test was performed using a U-tube manometer with a pressure of approximately 20 inches H_2O.

SECTION-D. PROBLEMS ENCOUNTERED

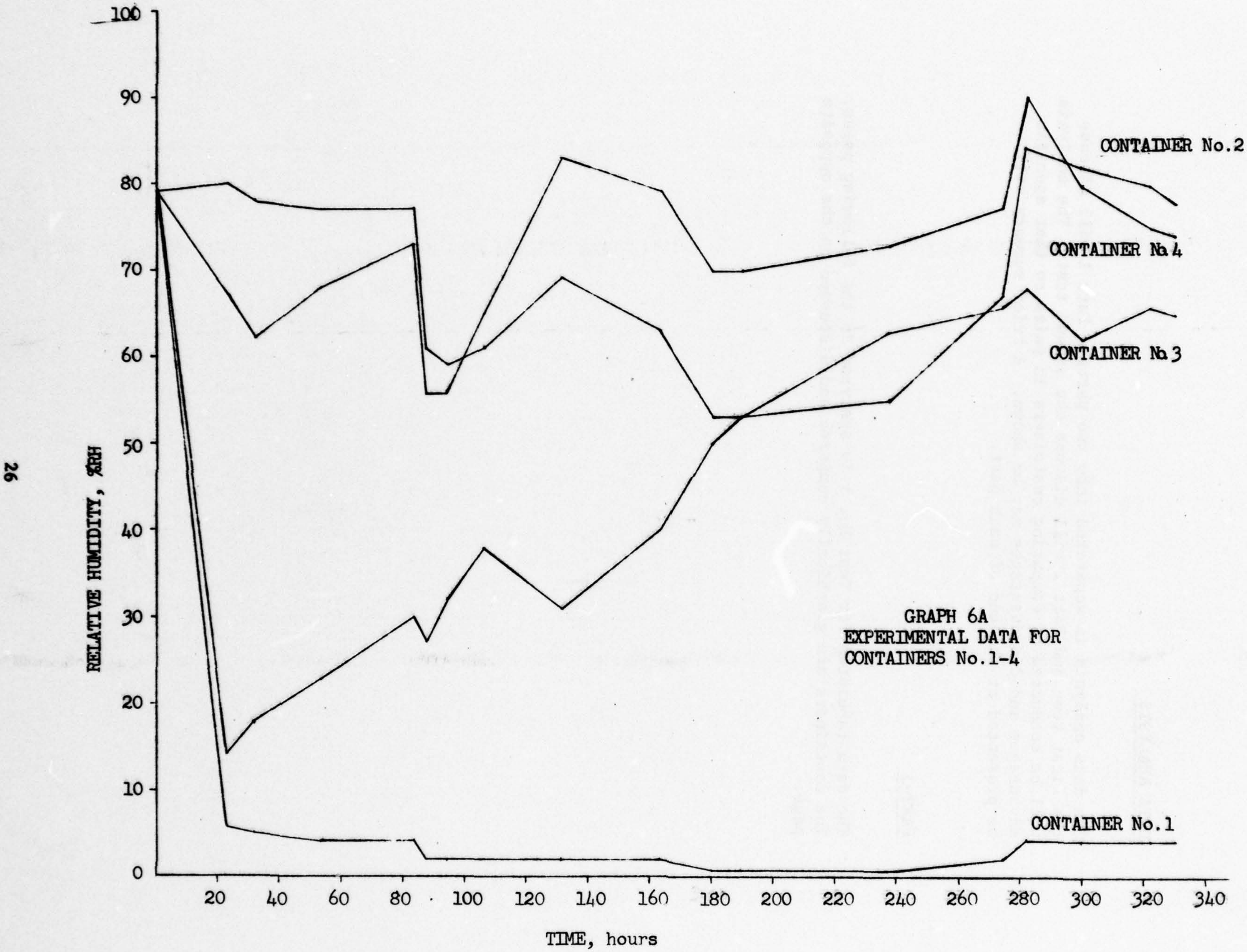
Original intent of the environmental test was to vary temperature while maintaining a constant relative humidity. However, shortly after the start of the test it became apparent that stabilizing the chamber would be rather difficult. Since the test was being conducted in the lower operating region of the chamber, precise control of the environment was made almost impossible. The chamber requires demineralized water for the humidification system and is supplied by a demineralizer unit with a 190 gallon life. This unit expired twice during the test and required replacement causing a variation in relative humidity during the test which was not expected.

DATA ANALYSIS

The data analysis is separated into two parts. Part 1 will discuss the first test and Part 2 will discuss the second test. The analysis will be conducted by comparing containers in pairs so that specific advantages and disadvantages may be shown. A brief summary will be presented at the end of each part.

PART-1

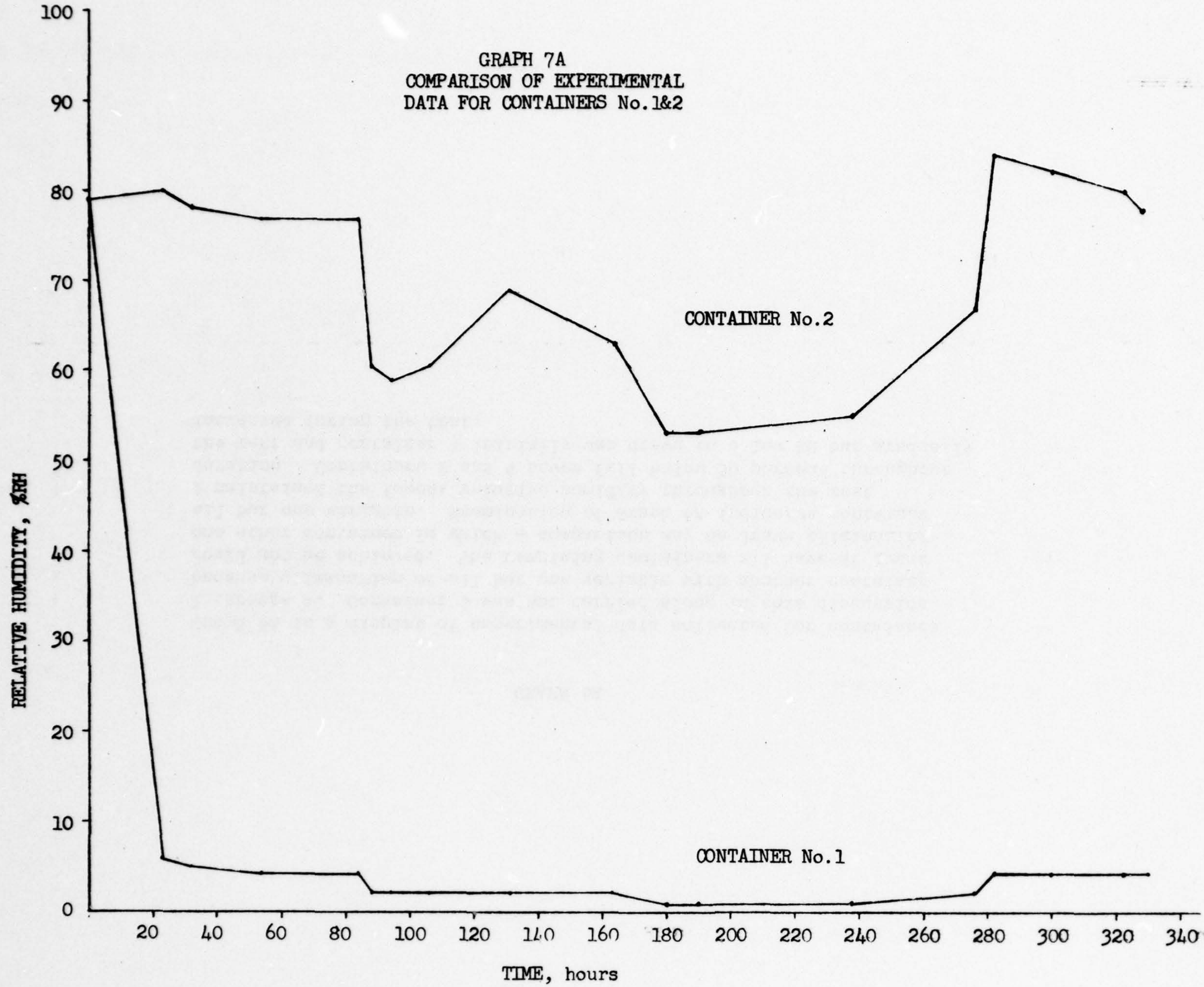
The data tabulated for Test No. 1 is analyzed in the following pages. The containers are graphically compared and discussed on the opposite page.



GRAPH 6A
EXPERIMENTAL DATA FOR
CONTAINERS No.1-4

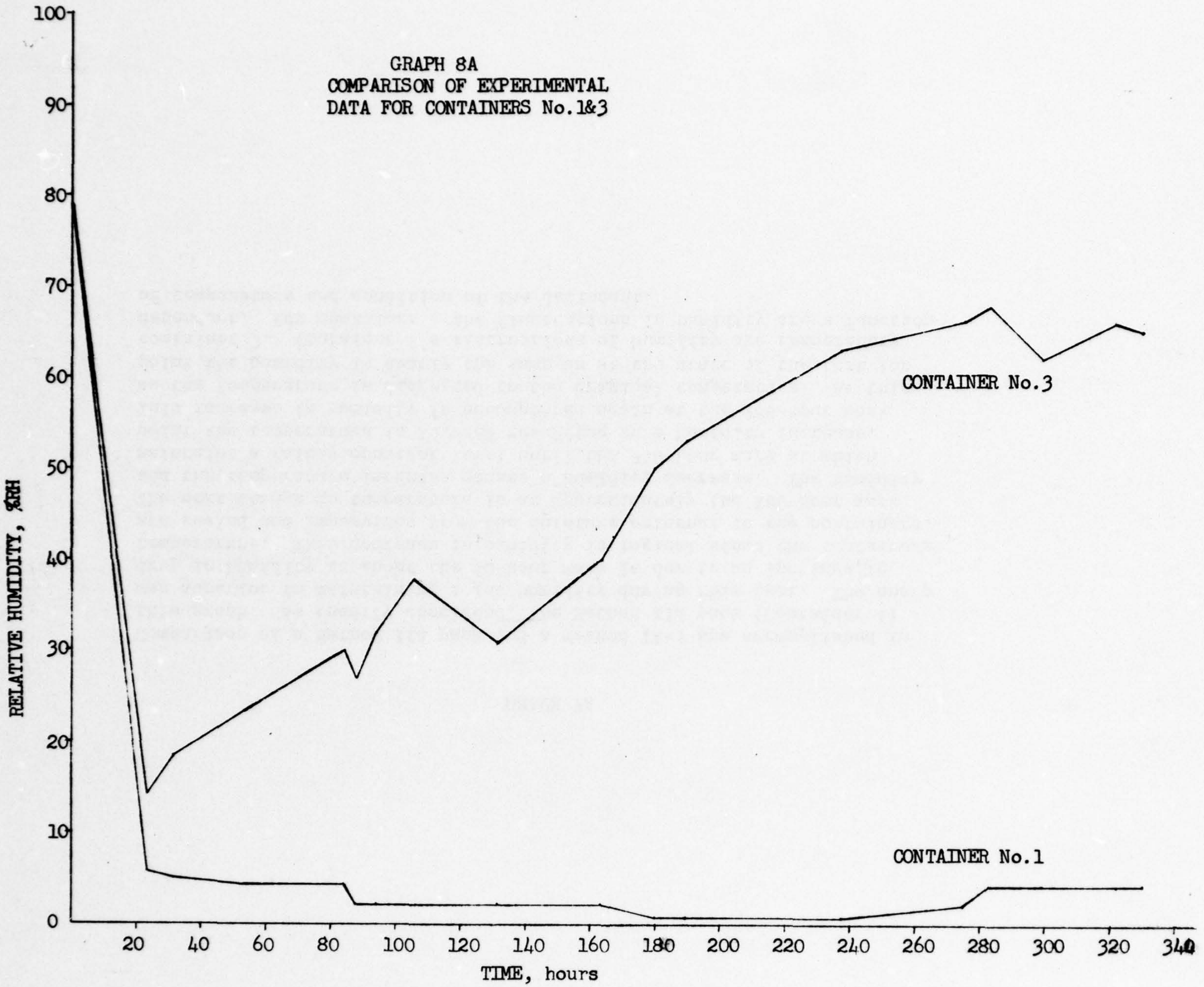
GRAPH 6A

Graph 6A is a display of experimental data collected for containers 1 through 4. Container 5 was not carried along in this discussion because elimination of all but one variable with another container could not be achieved. The remaining containers all have at least one other container in which a comparison may be drawn eliminating all but one variable. Examination of *Graph 6A* indicates container 1 maintained the lowest relative humidity throughout the test duration. Containers 2 and 4 never fell below 50 percent throughout the test and container 3 initially was drawn to a low RH but gradually increased during the test.


GRAPH 7A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.1&2
CONTAINER No.2
CONTAINER No.1
RELATIVE HUMIDITY, %RH
TIME, hours
100
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340

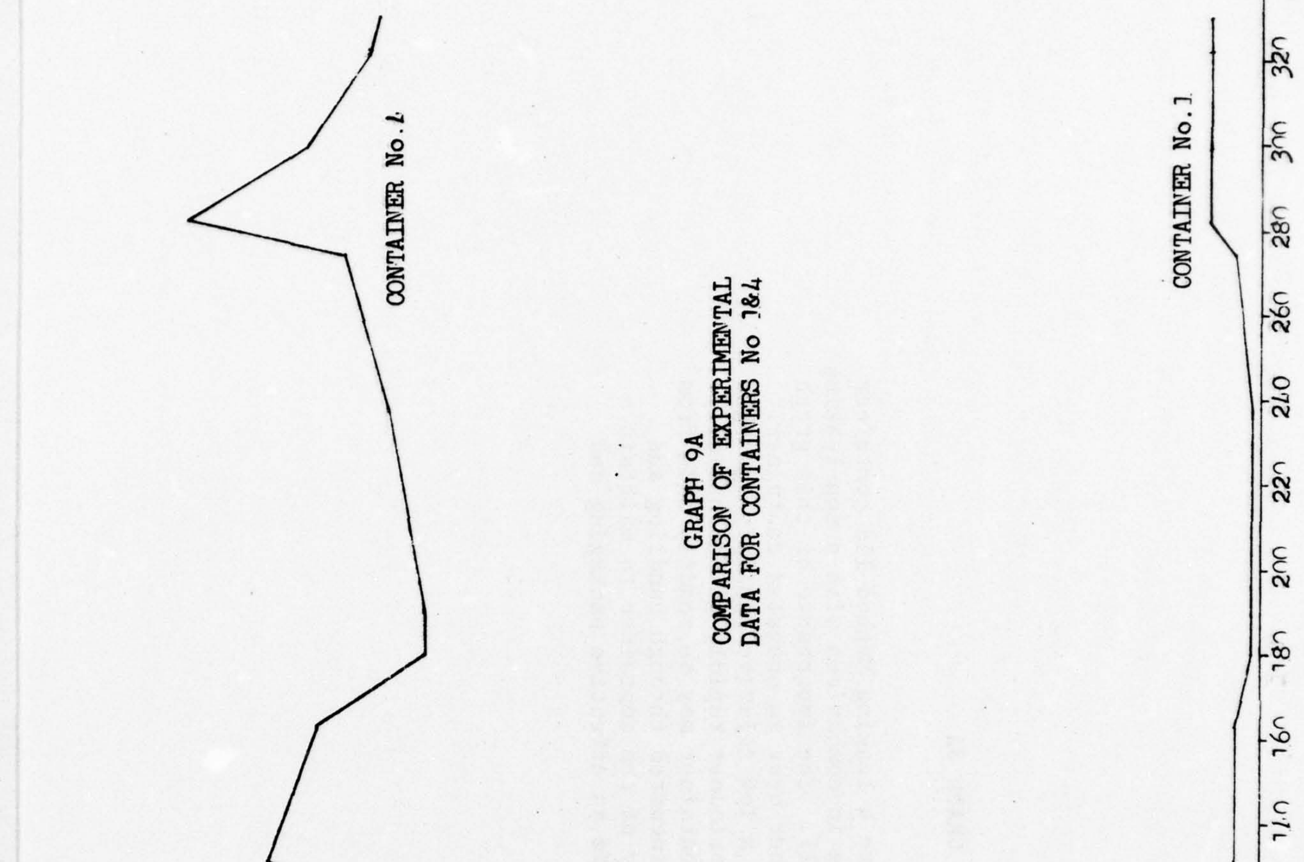
GRAPH 7A

Comparison of a Method IId pack and a Method IA-5 are accomplished in this graph. As readily concluded, the Method IId pack (Container 1) was superior in maintaining a low humidity during this test. The sharp drop in humidity at about the 80-hour mark is due to an increase in temperature. This decrease in humidity is logical since the containers are sealed and impervious from the moisture external to the containers. The next change in temperature is at approximately the 160-hour mark and the temperature increase causes a humidity decrease. The humidity maintains a fairly constant level until the 240-hour mark at which point the temperature is lowered resulting in a humidity increase. This increase in humidity is encountered again at the 280-hour mark as the temperature is decreased to the original temperature. At this point the humidity is nearly the same as at the start of the test for container 2. Container 2's fluctuations of humidity are temperature dependent. For container 1 the fluctuations in humidity are a function of temperature and condition of the desiccant.


GRAPH 8A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.1&3
RELATIVE HUMIDITY, %RH
0
10
20
30
40
50
60
70
80
90
100
TIME, hours
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
CONTAINER No.3
CONTAINER No.1

GRAPH 8A

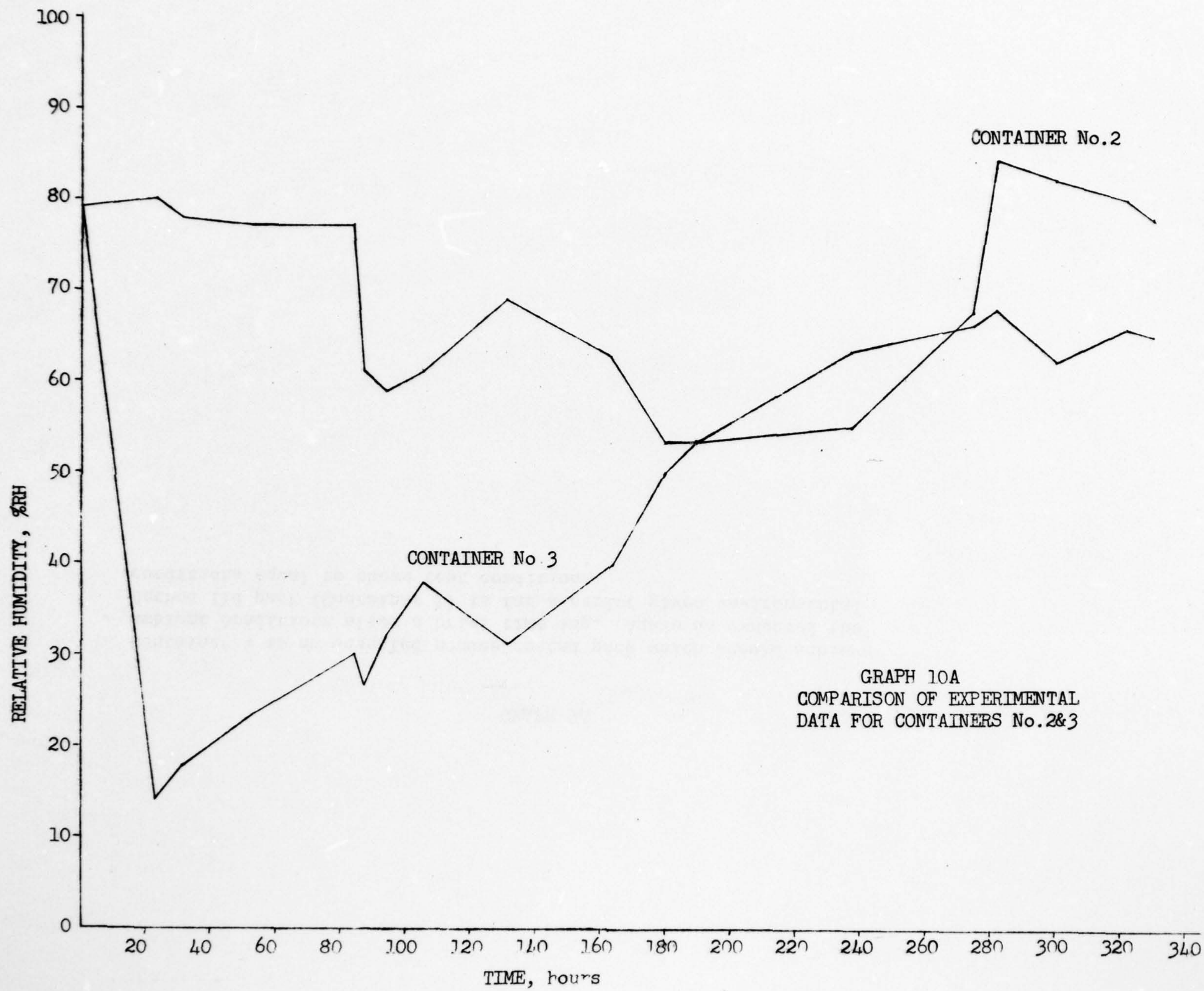
This graph is intended to simulate a leaking Method IId container (Container 3) and its performance in comparison with a non-leaking Method IId container (Container 1). The importance of this graph is the effect of a sealed container over an unsealed container. The sealed container remained at a low relative humidity throughout the test while the leaking container rapidly gained humidity as time progressed. A leaking container may be readily made from a sealed container if damage is incurred through handling and shipping. Therefore, the ability of the container to maintain a seal is a prime concern to provide an effective packaging and storage environment.



GRAPH 9A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No 1&4

GRAPH 9A

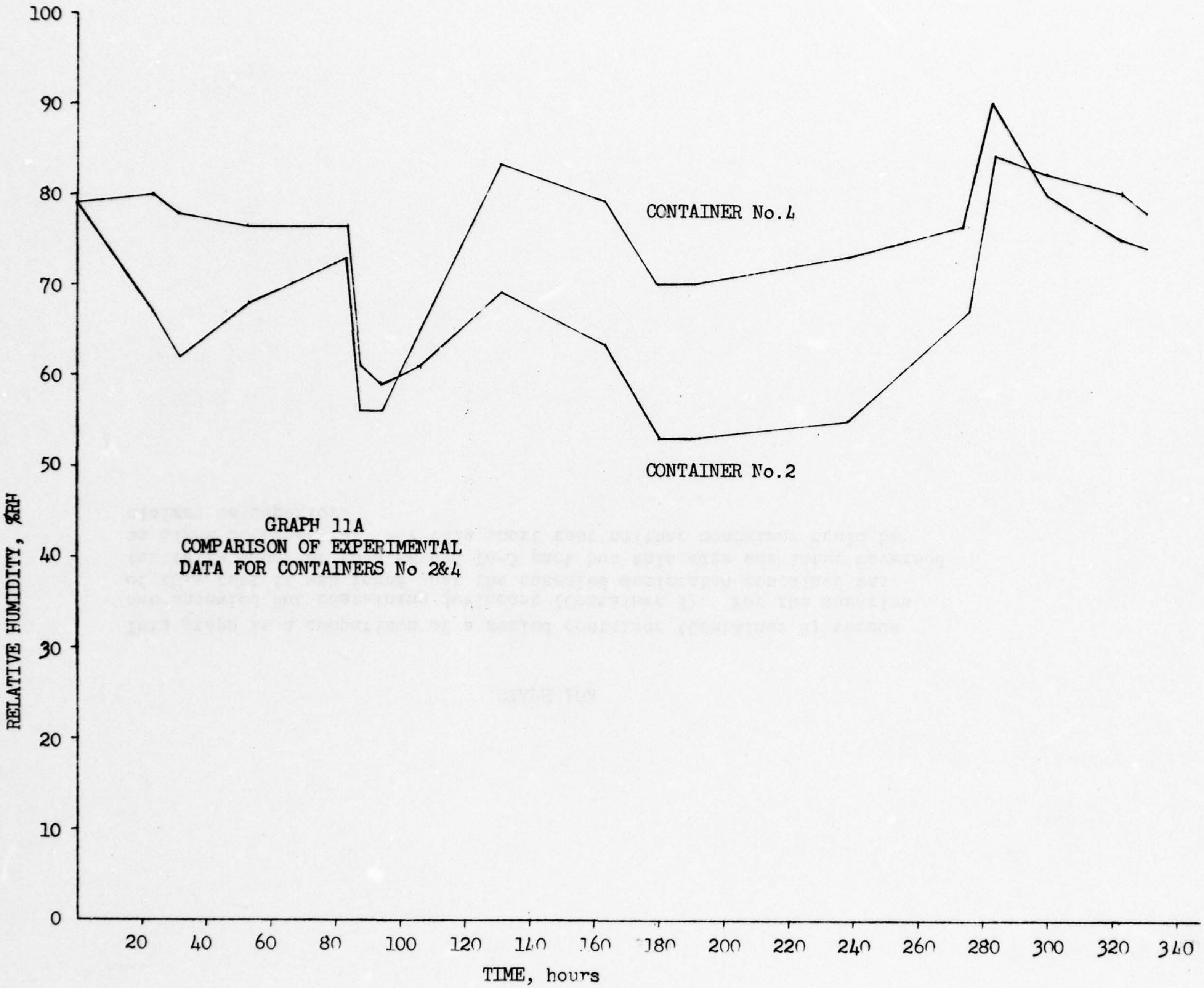
Container 4 is an unsealed nondesiccated pack which should achieve ambient conditions after a brief time lag. Again as expected the Method IId pack (Container 1) is far superior given environmental conditions equal to these test conditions.



GRAPH 10A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.2&3

GRAPH 10A

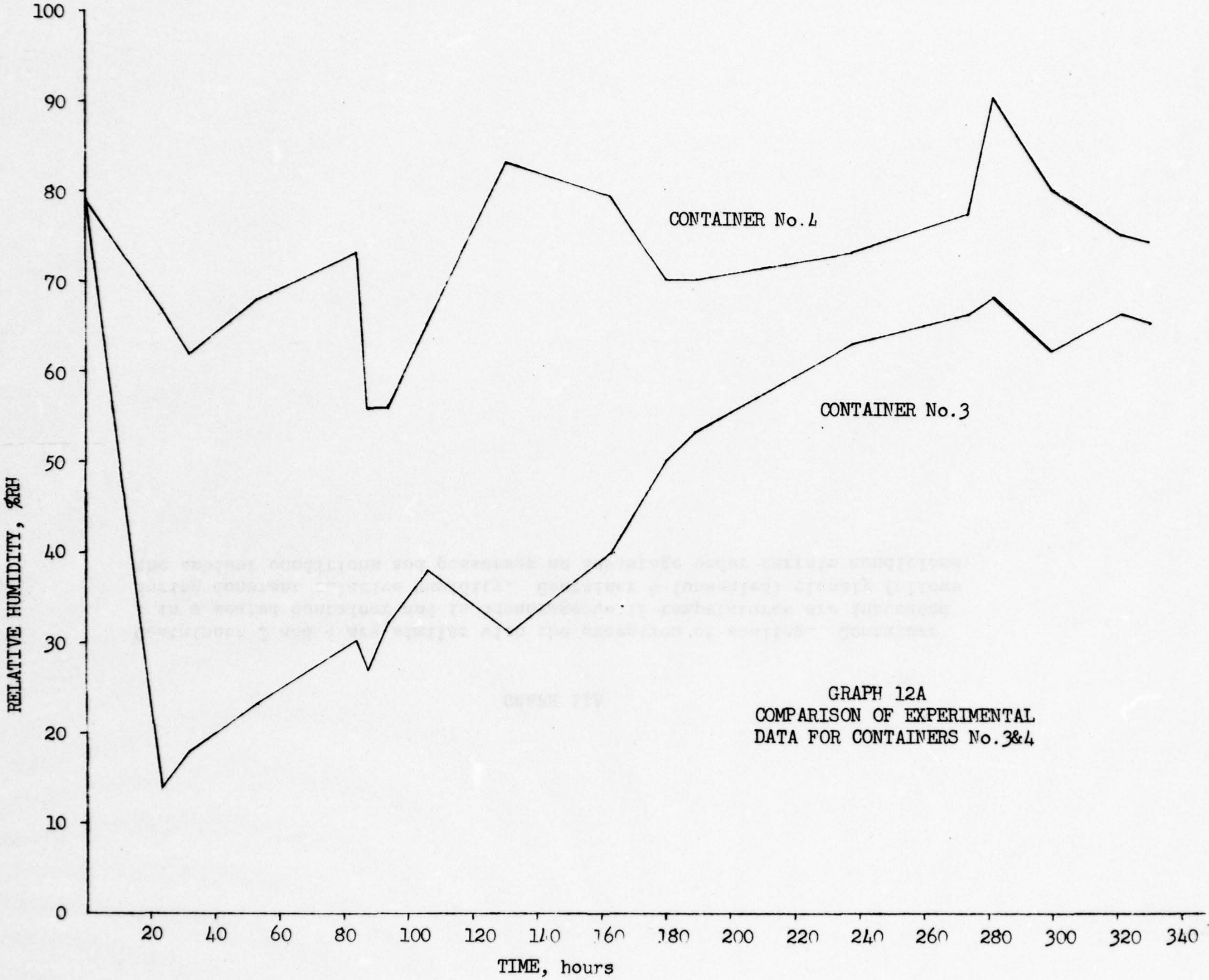
This graph is a comparison of a sealed container (Container 2) versus one unsealed but containing desiccant (Container 3). For the duration of this test it was found that the unsealed desiccated container was initially superior to a Method IA-5 pack but this edge was later reversed as might be expected. For this short test neither container could be claimed as superior.



GRAPH 11A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No 2&4

GRAPH 11A

Containers 2 and 4 are similar with the exception of sealing. Container 2 is a sealed container and is advantageous if temperatures are increased during constant relative humidity. Container 4 (unsealed) closely follows the ambient conditions and possesses an advantage under certain conditions.



GRAPH 12A
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.3&4

GRAPH 12A

Comparing leaking containers with and without desiccant give initial advantages to the desiccated container. But this container appears to rapidly approach the effectiveness of container 4 as the desiccant becomes saturated. The length of the test was not sufficient to predict container advantages. However, for the short duration test the desiccated unsealed container (Container 3) was at all times superior.

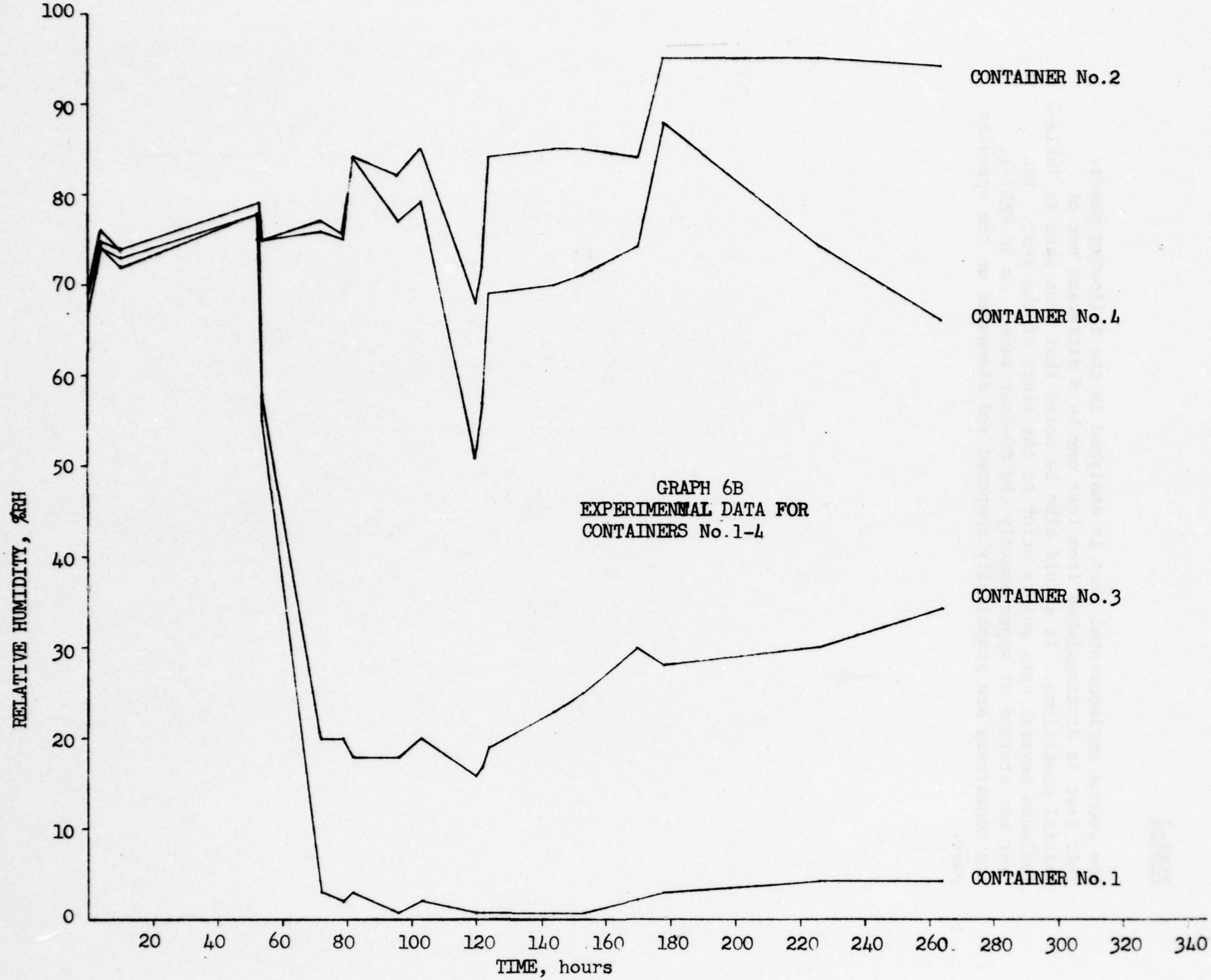
TEST #1 SUMMARY

The results of test #1 indicate that a Method IA-5 pack cannot approach the effectiveness of a Method IId pack. Since the internal conditions of a Method IA-5 pack are determined by initial conditions and subsequent temperatures, it is very important to seal a Method IA-5 pack at those conditions which will not damage the item by causing a large amount of moisture to be contained.

The desiccant in container 1 gained 2.4 grams while the desiccant in container 3 gained 17.4 grams. This is easily understandable since container 3 was not sealed. It should be evident that once a Method IId pack becomes unsealed, the internal environment gains moisture rapidly.

PART-2

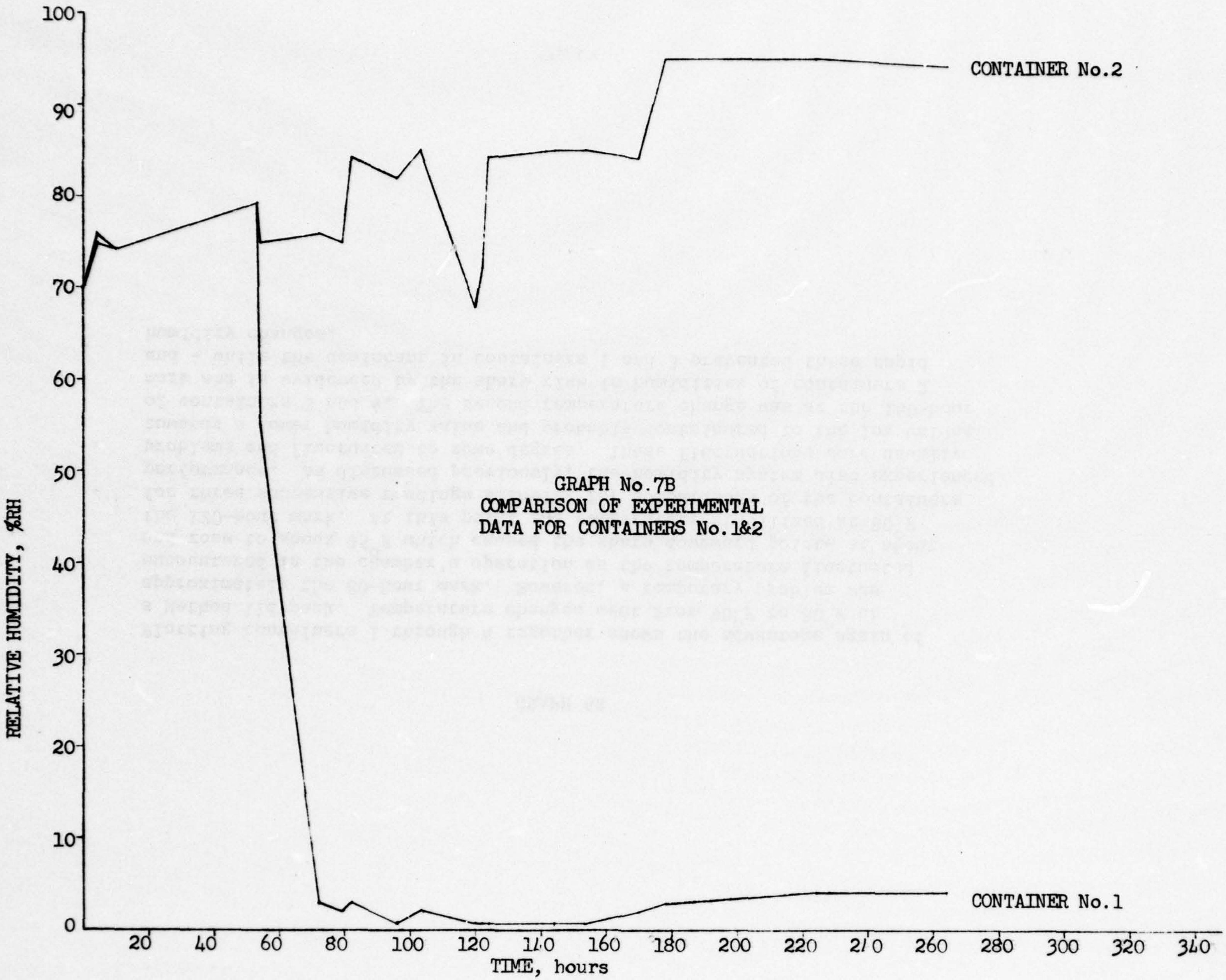
The second environmental test is analyzed in the following pages. This test is distinguished from test one by a different set of initial conditions. It should also be noted that test data in Table-2 includes several data points prior to the start of the test. The test was started at approximately the 60-hour mark. As in PART-1, the containers are graphically compared and discussed on the opposite page.



GRAPH 6B
EXPERIMENTAL DATA FOR
CONTAINERS No.1-4

GRAPH 6B

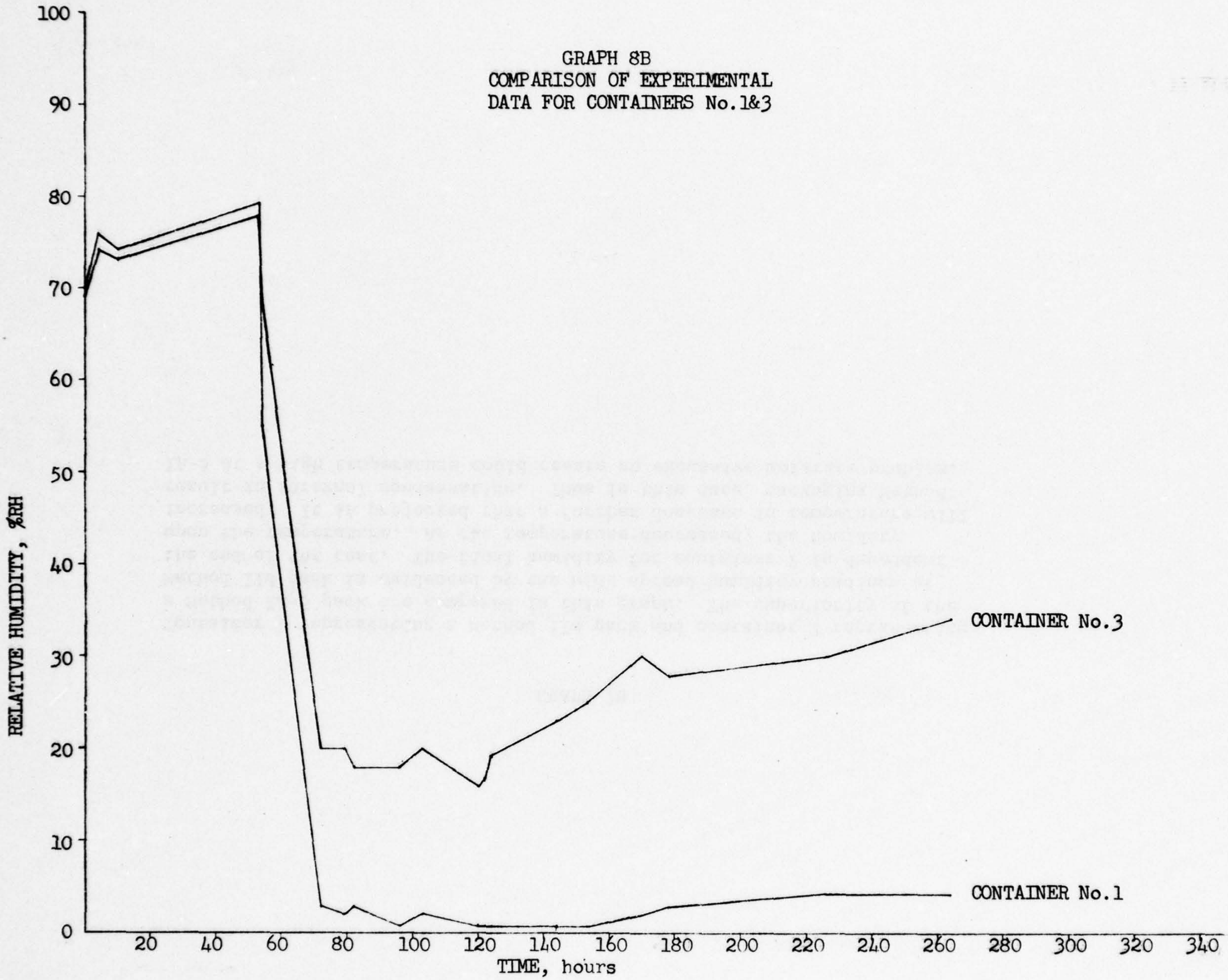
Plotting containers 1 through 4 together shows the advantage again of a Method IId pack. Temperature changes went from $90^{o}F$ to $80^{o}F$ at approximately the 80-hour mark. However, a temporary problem was encountered in the chamber's operation as the temperature fluctuated and rose to about $95^{o}F$ which caused the sharp downward points at about the 120-hour mark. At this point the temperature stabilized at $80^{o}F$ for three successive readings allowing for comparisons of the containers performance. As discussed previously, the humidity system also experienced problems and fluctuated to some degree. These fluctuations were usually towards a lower humidity value and probably contributed to the low values of containers 3 and 4. The second temperature change was at the 160-hour mark and is evidenced by the sharp rise in humidities of containers 2 and 4 while the desiccant in containers 1 and 3 prevented these rapid humidity changes.



GRAPH No.7B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.1&2

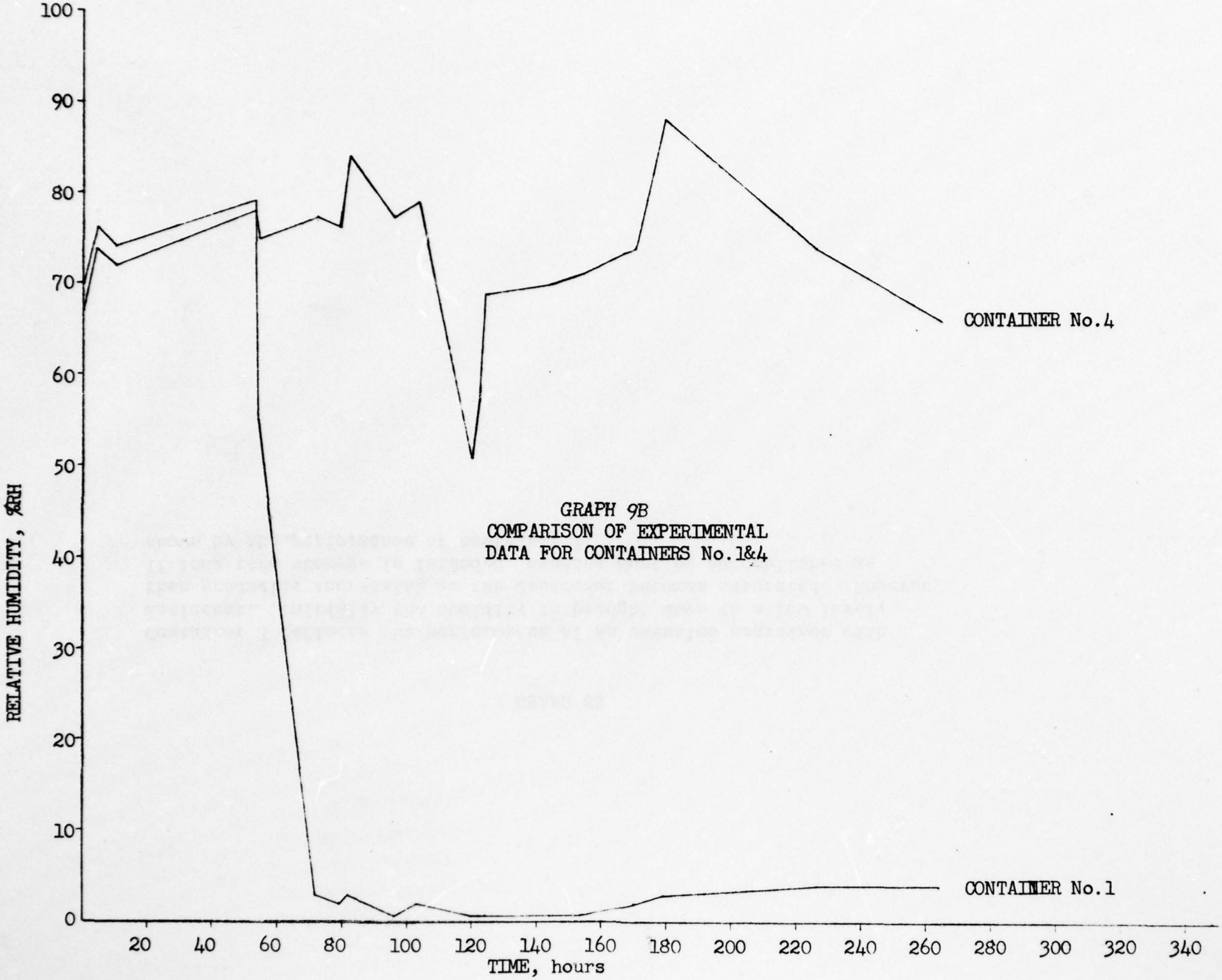
GRAPH 7B

Container 1 representing a Method IId pack and container 2 representing a Method IA-5 pack are compared in this graph. The superiority of the Method IId pack is evidenced by the wide spread humidity readings at the end of the test. The final humidity for container 2 is dependent upon the temperature. As the temperature decreased, the humidity increased. It is projected that a further decrease in temperature will result in internal condensation. Thus in this case, packaging Method IA-5 at a high temperature could create an excessive moisture problem.


GRAPH 8B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.1&3
RELATIVE HUMIDITY, %RH
TIME, hours
CONTAINER No.3
CONTAINER No.1
100
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340

GRAPH 8B

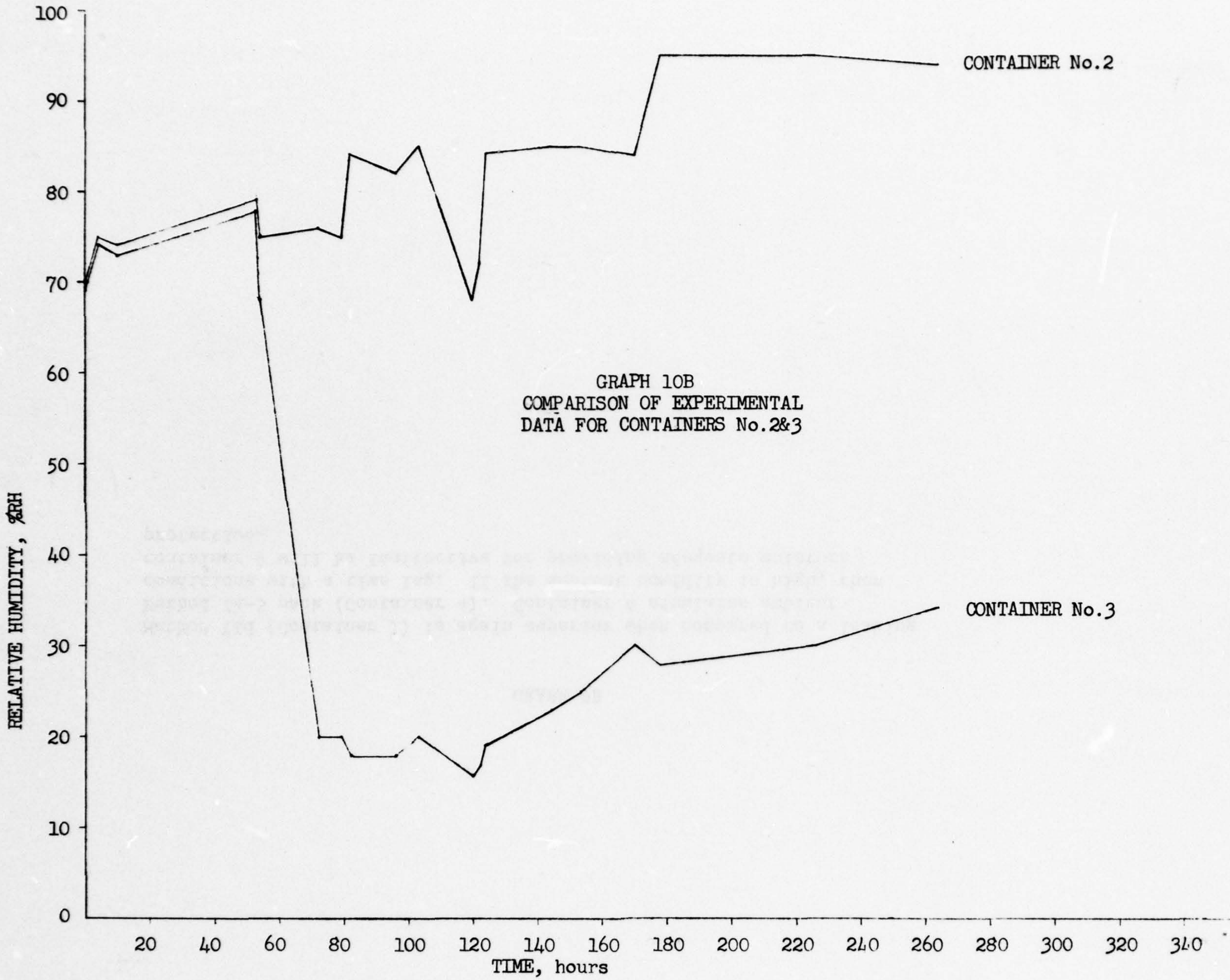
Container 3 reflects the performance of an unsealed container with desiccant. Initially the humidity is brought down to a low level, then gradually increasing as the desiccant becomes saturated. However, if long term storage is intended, sealing must be accomplished as shown by the performance of container 1.



GRAPH 9B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.1&4

GRAPH 9B

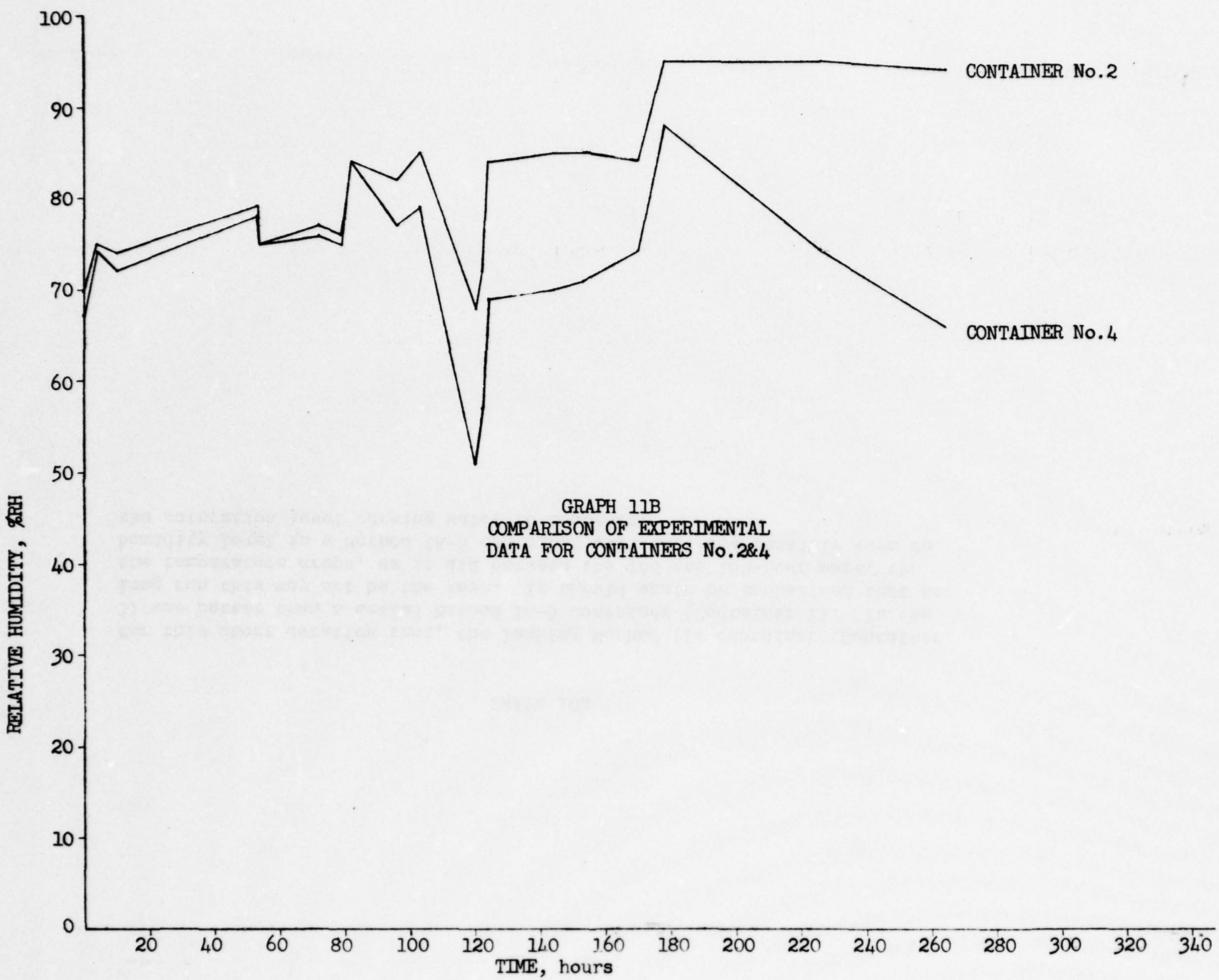
Method IId (Container 1) is again superior when compared to a leaking Method IA-5 pack (Container 4). Container 4 simulates ambient conditions with a time lag. If the ambient humidity is high, then container 4 will be ineffective for providing adequate moisture protection.



GRAPH 10B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.2&3

GRAPH 10B

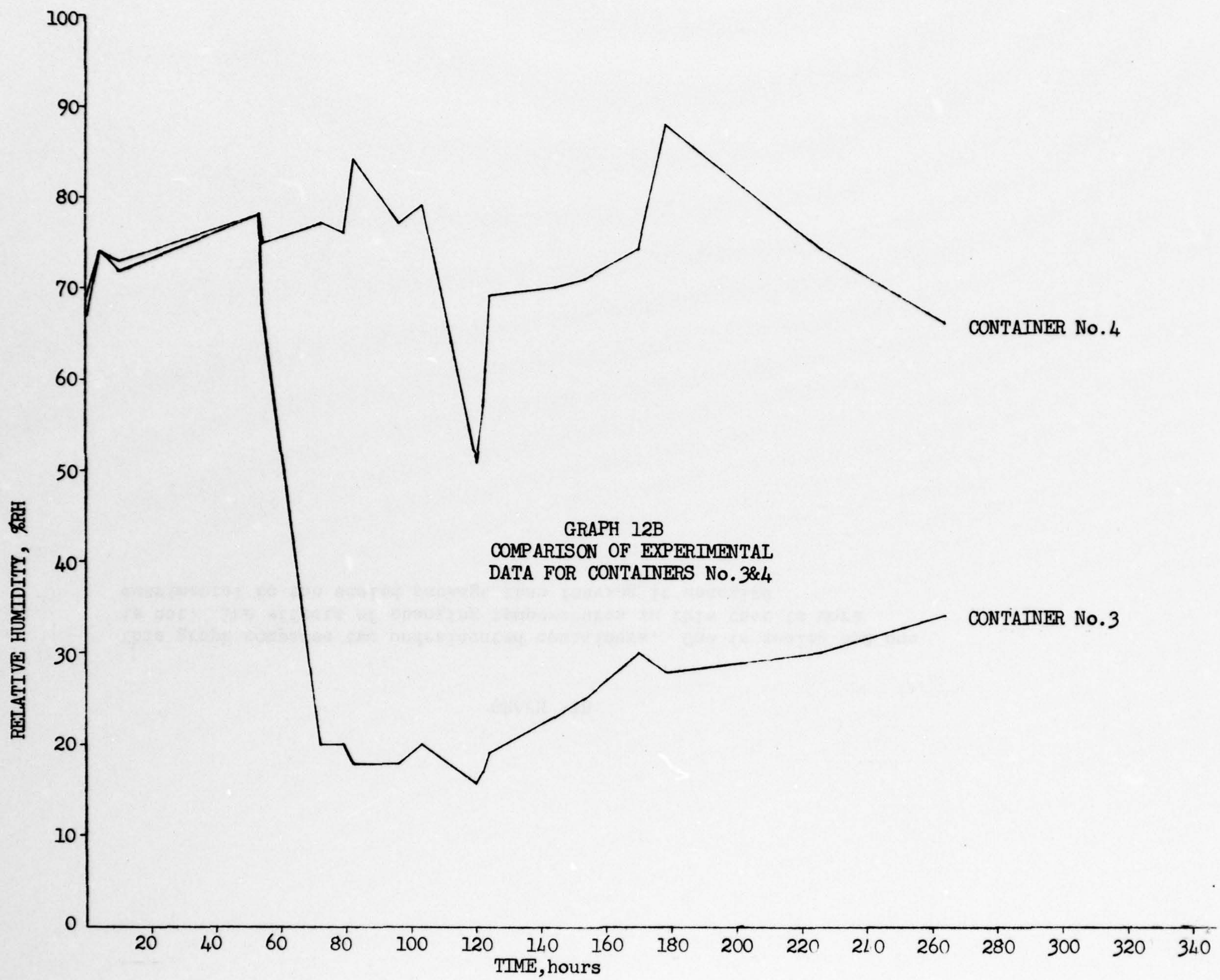
For this short duration test, the leaking Method IId container (Container 3) was better than a sealed Method IA-5 container (Container 2). In the long run this may not be the case. It should again be emphasized that as the temperature drops, as it did between the 160 and 180-hour mark, the humidity level in a Method IA-5 container will increase possibly even to the saturation level causing water to condense.



GRAPH 11B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.2&4

GRAPH 11B

This graph compares two undesiccated containers. One is sealed and one is not. The effects of changing temperatures in this test is more detrimental to the sealed package than leaving it unsealed.



GRAPH 12B
COMPARISON OF EXPERIMENTAL
DATA FOR CONTAINERS No.3&4
CONTAINER No.4
CONTAINER No.3
RELATIVE HUMIDITY, %RH
TIME,hours
0
10
20
30
40
50
60
70
80
90
100
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340

GRAPH 12B

In comparing leaking containers the desiccated pack (Container 3) performed better than a non-desiccated pack (Container 4) over a short test period.

TEST RUN #2 SUMMARY

Again in this test, the performance of the Method IId container was superior to that of the other containers. It must be emphasized that dry desiccant and sealability are important in achieving a proper Method IId pack.

Desiccant weight gain for container 1 was 3.2 grams and 12.9 grams for container 3. Thus, the container in a sealed desiccated configuration (container 1) is more adequate than a desiccated unsealed container (container 3).

CONCLUSIONS

After performing the previously described tests, examining various bits of information, and discussing data with the AFPEA engineering personnel the following conclusions have been formulated:

1. When properly prepared, a Method IId pack will provide very effective storage conditions. Properly prepared emphasizing the requirement of a sealed container and dry desiccant.

2. A Method IA-5 may be more harmful than good if not administered with care. A Method IA-5 container should be sealed at the lowest, or as low as practical, temperature encountered at the storage location if a low humidity condition is to be maintained.

3. A Method IId pack is superior to a Method IA-5 pack.

4. T.O. 00-85A-03-1 should not be changed to allow Method IA-5 packaging of nested external aircraft fuel tanks.

A P P E N D I X

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFLC)
HILL AIR FORCE BASE, UTAH 84406

REPLY TO ATTN OF: DST

1 [illegible]

SUBJECT: Reduced Levels of Packaging for Ogden ALC Prime Items

TO: AFALD/PTP

1. Forwarded for your information are the findings of tests recently completed on the effectiveness of using desiccant as a means of providing water/watervapor protection to the 370 and 600 gallon nested fuel tanks as presently packaged.

2. For the past two and a half years, our Packaging, Design & Application Section has been conducting tests to determine the effectiveness of using desiccant as a means of providing protection to items packaged Method II as opposed to items packaged Method IA. Various combinations of submethods of these two methods were used in the tests. A variety of programmed environments were used under controlled conditions to obtain the necessary data on the protection that each method actually provided.

3. As a result of the data acquired from these tests and the fact that the shipping and storage environment has changed along with the incorporation of better packaging materials, it is concluded that the use of desiccant as dictated by Method II does not provide any better protection than Method IA unless used under rigidly controlled surveillance. Consequently, we have directed all Packaging Specialists to review the method of preservation, packaging and packing in order to obtain a more realistic form of protection in terms of cost and materials according to reduced levels. The majority of those items that are now packaged Method II will be packaged Method IA or lower depending on their usage and storage environment.

4. Action has already been taken to reduce the level of packaging from Method IId to Method IA-5 for the 370 and 600 gallon nested fuel tanks. This does not mean that those items presently packaged Method II will have the desiccant immediately removed but that all new or repaired items will be packaged with the preferred Method IA as they are generated into the distribution system.

5. Since the above action will require some changes, we request that TO 00-85A-03-1 be revised to accommodate Method IA-5 preservation:

a. Paragraph ~~4.4.b.~~ 3.4b. Add the following, "When the applicable packaging TPO specifies non-desiccated preservation (Method IA-5), the inspection shall be accomplished annually by inspecting five percent (unless otherwise determined) of the containers located in outside storage five years or more since the date packed."

b. <u>Paragraph ~~4.8~~.</u> 2.7 Change the last part of the second sentence to read, "or during annual inspections." (see paragraphs ~~4.2~~ 2.5, 4.4.b and ~~4.5.~~ 3.5).

Leo M Harris

1 Atch
Test Report

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REPORT ON COMPARISON STUDY TO DETERMINE THE EFFECTIVENESS OF USING DESICCANT IN FUEL TANK CONTAINERS

1. Tests have been conducted to determine the feasibility of continuing to utilize desiccant as a means of providing watervaporproof protection to the 370 and 600 gallon nested fuel tanks as packaged in their present configuration and placed in outside storage. These tanks are packaged in accordance with TPO 1560-00-072-5507, configuration no. 2 for 600 gallon and TPO 1560-00-738-2462, configuration no. 3 for 370 gallon, using metal containers in accordance with MIL-C-9361 and are presently being stored in the 02 storage lot. The tests were conducted in two phases which consisted of the following:

a. Phase I - Record the ambient temperature and percent of relative humidity present inside the sealed container with the desiccant removed and the ambient air temperature and relative humidity present outside of the container.

b. Phase II - Record the ambient temperature and percent of relative humidity present inside the sealed container with desiccant intact and the ambient air temperature and relative humidity present outside of the container.

2. Equipment used to record the obtained data are Taylor Temperature/ Humidity Recorders, serial numbers 1252 and 1289.

3. The procedures followed for both phases of the test were essentially the same, the only difference being the removal of the desiccant for Phase I. The containers were selected at random and were not preconditioned prior to the start of tests. It must be noted that in the selection of the containers, the criteria used was that the chance of these containers being shipped or moved had to be non-existent for at least the next six months. The steps followed were:

a. A Taylor T/H recorder, serial no. 1252, was placed in the forward end of the container, this involved removing the cover and a small parts box that was secured to same in order to provide room for the recorder. These parts were placed in the void behind the recorder.

b. The Taylor T/H recorder, serial no. 1289, was placed in an instrument shelter located outside and adjacent to the test container.

c. The recorded charts were changed on a weekly basis on both instruments which involved removing the sealed cover of the test container to change the chart but also allowed for inspection on the inside of the container for any penetration of water/watervapor.

d. The data that was collected was broken down to find the average mean temperature and percent of relative humidity for the week on the inside of the container and on the outside in the natural environment with the extremes noted for both readings. Note: In both tests, the 16-unit bag of desiccant that had been placed over the plug-type humidity indicator was removed. In Phase I it was removed from the container and in Phase II it was placed under the Taylor T/H recorder away from the humidity indicator.

e. Phase I was begun on 16 Nov 76 at 10:30 AM and was stopped on 25 Jan 77 at 12:30 PM, at which time Phase II was begun and was concluded 18 Mar 77 at 1:30 PM.

4. The results of these tests to date are as follows:

a. Phase I (Without Desiccant)

(1) The acquired data has indicated that relative humidity within the container has remained constant with an average of 26% during the period of the test with a high recorded the 16 Nov of 35% when the test was begun but which stablized on the 26 of Nov at 26% where it has remained.

(2) The humidity indicator continued to read blue throughout the test and does so at the date of this report even though the desiccant has not been returned to the container.

(3) Temperature inside the container ranged from a high of 50°F (10°C) to a low of 6°F (-15.6°C) with an average of 27°F (-2.8°C) during the period of the test.

(4) There was no condensation of moisture or evidence of water/watervapor within the container at any time during the test.

(5) Outside temperatures ranged from a high of 52°F (11.1°C) to a low of 7°F (-14.9°C) with an average mean temperature of 25°F (-3.9°C). The percent of relative humidity ranged from a high of 100% for 40 hours to a low of 45%. The average for the period of the test was 71%.

(6) The barometric readings for this period ranged from a high of 30.93 inches of mercury to a low of 29.21 inches of mercury with an average of 30.47 inches of mercury.

b. Phase II (With Desiccant)

(1) The acquired data to date has indicated a fluctuation in the percent of relative humidity within the container, with a high of 36% and a low of 25% and an average of 27% during the period of the test.

(2) The humidity indicator has read blue during the test and does so at the date of this report.

(3) Temperature inside the container ranged from a high of 56°F (13.3°C) to a low of 16°F (-8.9°C) with an average of 36°F (2.2°C) during the period of the test.

(4) There was no condensation of moisture or evidence of water/ watervapor within the container at any time during the test.

(5) Outside temperatures ranged from a high of 50°F (10°C) to a low of 17°F (-8.3°C) with an average mean temperature of 32°F (0°C). The percent of relative humidity ranged from a high of 100% for 51 hours to a low of 38%. The average for the period of the test was 81%.

(6) The barometric readings for this period ranged from a high of 30.32 inches of mercury to a low of 29.16 inches of mercury with an average of 29.86 inches of mercury.

5. These tests will be continued in order to glean as much data as possible to support a recommendation for total removal of desiccant as a means of providing watervapor protection. It is apparent from the data obtained to date that the use of desiccant and the protection it provides is questionable and not justified. In Phase II, the data acquired indicates an erratic behavior in the humidity and the ability of it to stabilize over a seven day period. This condition existed over the entire period of the test. In Phase I this condition did not exist.

6. The practice of placing a 16-unit bag of desiccant over the humidity indicator is deceptive and allows for erroneous readings leading to unnecessary expense in replacing the humidity indicator and desiccant and labor involved in the handling and examination of the item.

7. As a result of these tests, the following recommendations are presented for consideration:

a. That the present method of protection of IId be changed to Method IA-5.

b. That all documents pertaining to the packaging of these items be changed to correspond with the recommended method.

c. That continuing tests in this area be performed by AFALD/PTP to substantiate and enhance data already obtained in this area.

d. That the present inspection procedure requiring tank containers to be opened and inspected when indicators read pink be discontinued. Inspection should be limited to visual inspection to determine if holes are evident above the 8 O'clock and 4 O'clock positions. Minor holes below these positions do not cause corrosion problems.

3.

TECHNICAL ORDER SYSTEM PUBLICATION IMPROVEMENT REPORT AND REPLY

FORM APPROVED OMB NO. 21–R0207

1. TO: (Major Command or equivalent)	2. TO: (Orgn having Mgmt Responsibility for the T.O.)	3. FROM (Orgn reporting)	4. REPORT DATE YR MO DAY
Oklahoma City ALC Tinker AFB OK 73145	MMST	Ogden ALC/DSQMB	77 04 11

5. BASIC DATE OF T.O.	6. DATE OF T.O. CHANGE	7. PAGE NUMBER	8. PARAGRAPH NUMBER	9. FIGURE NUMBER
Oct 1, 1976	None	3-1	3-2	

DOC IDENT (1-3)	TO (4)	FROM (5)	TECHNICAL ORDER NUMBER (6-30) AFALD/PTPD	IMPROVEMENT REPORT NUMBER (31-45)
X Y A	H	H	00-85A-03-1	2FSQMBALC7001R

10. BRIEF SUMMARY OF DEFICIENCY AND RECOMMENDED CHANGE (Use continuation sheets if necessary)

Deficiency: Tests conducted at OO-ALC/DSTCT indicate that a Method II Pack does not serve the best interest of the Air Force in the corrosion control of nested fuel tanks. No benefit is derived and the expense is not justified.

Recommendation: Para 3.2 to read: "Nested tanks shall be preserved, packaged, packed and prepared for storage in accordance with applicable transportation packaging order and/or Method II, specifications . . . ." (and continue on as presently written).

1 Atch
Test Report

NOTE: This change recommended by OO-ALC/DSTC.

PTPD. FILE COPY

11. REPORTED BY (Initiator's Signature, OAS and Extension)	12. APPROVED BY (Supervisor's Signature)	13. QUALITY CONTROL (Signature)
SIGNED WILLIS J. MICHAELSON/DSQMB/5665-6425	SIGNED ARDEN L SANDALL	SIGNED KENNETH ROBERTSON

14. MAJOR COMMAND ACTION	15. (Check applicable block) ☐ APPROVED ☐ DISAPPROVED	16. SIGNATURE (Major Command Authority)	17. DATE

	TR CODE (46-48)	DATE RECEIVED YR MO DAY (49-54)	DATE TO MGR YR MO DAY (55-60)	MGR (61)	TRANSFER CODE (62-66)	DOWNGRADED (67)	(Reserved) (68-80)
☐	D A A	77 04 15	77 04 15				

	TR CODE (46-48)	DATE FROM MGR YR MO DAY (49-54)	ACTION TAKEN (55-66)	RESOLUTION DATE YR MO DAY (67-72)	(Reserved) (73-80)
☐	D B A				

18. TO: (Major Command or equivalent)	19. TO: (Organization Reporting Improvement)	20. FROM (SM/IM)
Oklahoma City ALC/MMST Tinker AFB OK 73145	Ogden ALC/DSQMB Hill AFB UT 84406	AFALD/PTPD Wright-Patterson AFB OH 45433

21. REMARKS Use continuation sheets if necessary) Recommended change to para 3.2 is unacceptable at the present time. The tests referred to in the deficiency section are insufficient to grant the proposed change. However, the basic point may be substantiated by further investigation. To pursue this point, AFALD/PTPD is conducting an evaluation for deleting the desiccant requirement in response to this AFTO Form 22 and a follow-up letter submitted by OO-ALC/DSTC. After the results are determined, the appropriate action in regards to TO 00-85A-03-1 will be initiated. Tentative completion date of the AFALD/PTPD evaluation is 2 September 1977.

22. DATE OF REPLY	23. REPLY BY (Signature, OAS, Extension)	24. APPROVED BY (Supervisor)
3 August 1977	Daryl Edwards AFALD/PTPD/73120/73362	SIGNED

AFTO FORM 22 APR 73 REPLACES AFTO FORMS 22 AND 22A WHICH ARE OBSOLETE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFLC)
HILL AIR FORCE BASE, UTAH 84406

REPLY TO ATTN OF: DSTC

1 JUN 1977

SUBJECT: Revisions to TO 00-85A-03-1

TO: AFLC/PTPD (Frank Yeager)

1. Request the following changes to TO 00-85A-03-1 as soon as possible. These changes are required when preservation method IA-5 is specified by the prime ALC.

a. Paragraph 3-2. Change first sentence to read "Nested tanks shall be preserved, packaged, packed and prepared for storage in accordance with method II, specifications MIL-P-116, MIL-T-7378, and MIL-B-9361, except that the F4 600 and 370 gallon tanks shall be method IA-5 according to Ogden ALC TPOs.

b. Paragraph 3-4b. Add to last sentence "except for F4 600 and 370 gallon tanks." Loaded F4 nested fuel containers shall be inspected once each year, usually each July. Containers that have been in storage five years or more since the date of pack shall be further inspected according to paragraph 3-7.

c. Paragraph 3-8. Change remarks within the parentheses of the second sentence to read "(see paragraphs 3-2, 3-5, 3-8a, through 3-8d)". Add new subparagraphs 3-8a through 3-8d as follows:

(1) Paragraph 3-8a. The provisions of paragraph 3-8 shall apply except that when inspecting F4 600 gallon and 370 gallon tanks, opening of the container based on the humidity indicator reading shall not apply. In lieu of inspection, procedures prescribed in paragraph 3-8b shall be used.

(2) Paragraph 3-8b. F4 600 and 370 gallon loaded tank containers shall be inspected according to the procedures specified in MIL-STD-105, Inspection Level 1, using a double sampling plan and an AQL of 2.5. A lot shall comprise of all containers in storage in excess of five years since the date of pack.

(3) Paragraph 3-8c. The loaded tank containers shall be inspected for all discrepancies specified in 3-8 except that the end cover containing desiccant shall be removed, and the inner container and contents shall be inspected for evidence of corrosion and moisture caused by punctures or leaks caused by corrosive attack to the metal container. If an acceptable AQL is not reached after conducting the double sample plan, the reasons for rejection shall be reported to Ogden ALC for resolution.

AFLC - LIFELINE OF THE AEROSPACE TEAM

(4) Paragraph 3-8d. Desiccant shall be removed and omitted from all containers inspected.

d. Nested tanks made reparable because of excessive corrosion attack shall be reported to OO-ALC for disposition and replacement action.

e. Paragraph 3-17f. Add to last sentence, "replacement not required on F4 tank containers."

2. The above changes are forwarded according to telephone agreement between Mr Henzi, OO-ALC/DSTC and Mr Yeager, AFLC/PTPD.

Phil Alsup

PHIL ALSUP
Packaging Support Br
Directorate of Distribution

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CONTAINERS	PRESERVATION	FUEL TANKS
PACKAGING	DESICCANT	STORAGE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Two experimental tests were conducted to evaluate the relative effectiveness of military specification MIL-P-116 Methods IA-5 and IId. The objective was to determine whether Method IA-5 could be specified instead of Method IId for nested external aircraft fuel tanks in MIL-C-9361 containers. The conclusions of the test show that Method IId is superior to Method IA-5 when properly prepared. Also, shown was the possibility of the Method IA-5 causing more harm than good if improperly used. Therefore, the Method IId preservation-packaging requirement for storage is necessary in lieu of Method IA-5.

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